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SCIENTIFIC AMERICAN

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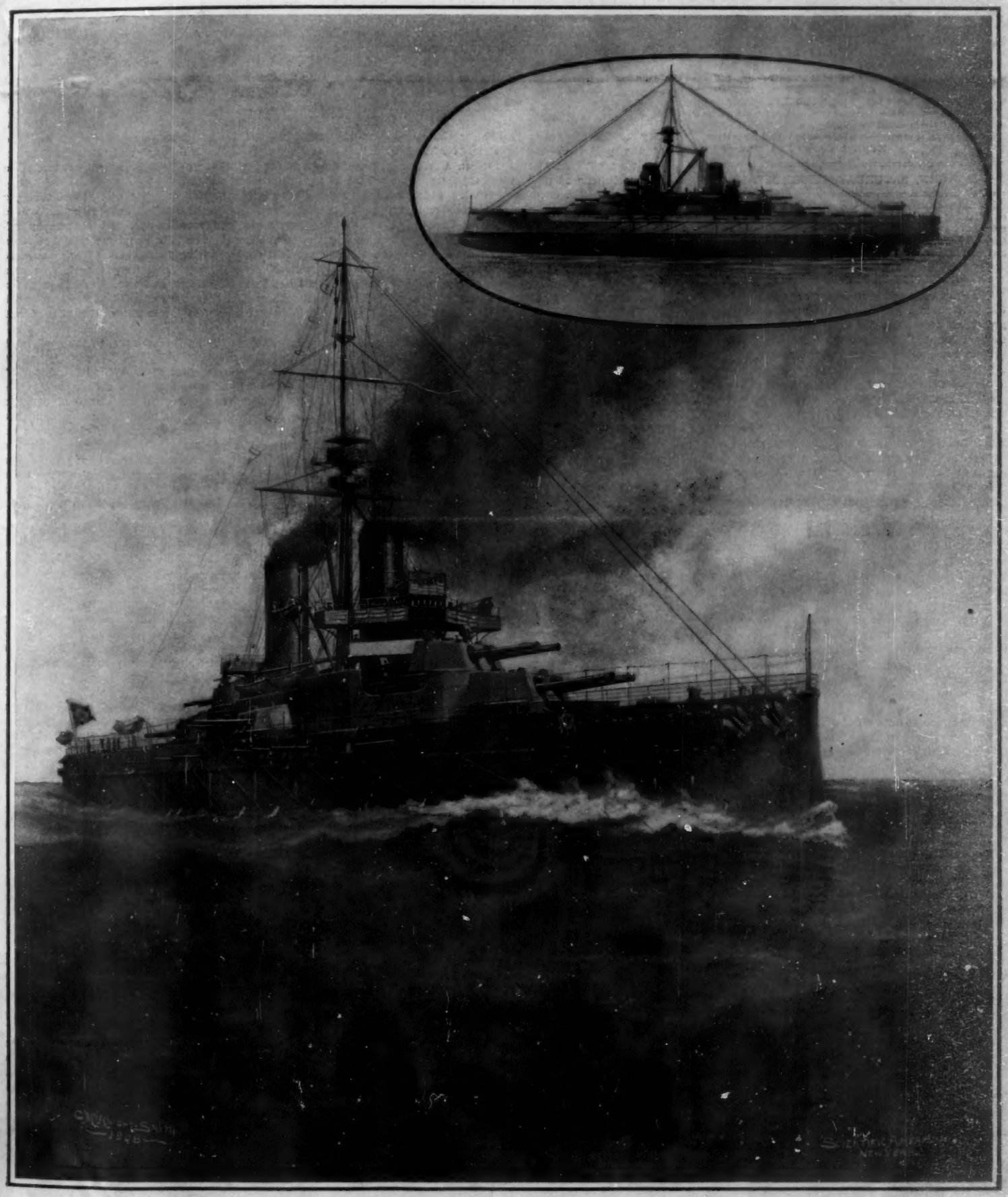

Displacement, 19,500 tons. **Speed,** 21 knots. **Coal,** 2,000 tons. **Armament:** Twelve 12 inch; twenty-two 4.7-inch guns. **Armor:** Belt, 9-inch; turrets, 9-inch; deck, 2¾-inch.

This is one of three sister ships which will form the backbone of the new Brazilian navy.

THE NEW BRAZILIAN "DREADNOUGHT" TYPE BATTLESHIP "MINAS GERAES."—[See page 428.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, DECEMBER 12, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

LEGISLATION TO PREVENT FOREST FIRES.

The frequency and seriousness of forest fires during the past autumn prove that the present laws for the protection of the forests are inadequate. We are of the opinion that negligence or inexcusable carelessness is responsible for the majority of the fires, not merely in the Adirondack regions, but also in the fire-swept districts of Minnesota, Michigan, and Wisconsin. If this carelessness be measured by the magnitude of the disasters of which it is the original cause, it takes on surely a strong flavor of criminality. For it is no excuse to say that the hunter who fails to extinguish his campfire, or the settler who leaves the edges of his clearing burning through the night in proximity to inflammable forest timber, does so without any thought of the loss of life or property which may result from his carelessness; for he is well aware of the fact that such smoldering fires may, and do, start great conflagrations, and that in these conflagrations it frequently happens that not one but many human lives are sacrificed. If such carelessness in the presence of this knowledge be not criminal, a new definition must be found for this last-named word.

Our attention has recently been drawn to the fact that in Canada there is a strong movement on foot, urging the government to follow a more definite course of action in the protection of the forests, and to make the breach of the forest-protection laws punishable by imprisonment, without the option of any fine. The object aimed at by the suggested legislation is, not merely to increase the number and enlarge the powers of the forest wardens, but also to compel every camper to either extinguish his fire or keep it under guard; to require every settler, railway contractor, or railway, in clearing lands, to maintain a guard by night as well as by day, so long as the stumps are burning, and to prevent any stumps or underbrush being fired within a reasonable distance of the standing timber; and finally, to make the railways and factories whose tracks or works are within the forest area responsible for the protection of the forest to a given distance on each side of the railway track or factory.

We commend this subject to the attention of the legislatures in those States most nearly affected. It is certain that legislation bringing the careless starting and neglect of fires within the range of the criminal law would prove a most speedy and effective check upon the present annual destruction of life and property.

NEWPORT CONFERENCE APPROVES DESIGNS OF NEW BATTLESHIPS.

The fact that the Newport Conference, which was composed of over fifty sea-going officers and only four officers of the Construction Corps, has approved of the design of the "North Dakota" and "Utah" classes, must be considered as the most complete refutation of the recent criticism of our navy that could possibly have occurred. There is no gainsaying the significant character of this Conference. In age, experience, and ability, and the varied rank represented, the Conference was broadly representative of the navy, and the people of the United States may accept its word of approval as final.

The motive for the Conference is to be found in that campaign of bitter criticism of our warships as built, building, and designed, which, originating about a year ago in an article that appeared in a monthly magazine, culminated in a recent letter of Commander Key, U. S. N., addressed to the Navy Department, which contained a criticism of the designs of the "Delaware" and "North Dakota." Commander Key's criticisms, briefly summarized, were as follows: First, that the 5-inch armor protecting the secondary battery should be removed as useless, and the weight devoted to turrets in which these guns should be emplaced, or, as an alternative, that the 5-inch guns should be mounted on the tops of the 12-inch gun turrets; that more protection should be given to the ends of the "North Dakota"; that the location of a certain magazine between the engine and fire rooms was inadvisable; that No. 3 turret should be placed abaft the engine room; and that Nos. 3, 4, and 5 turrets should be placed diagonally across the after deck, so as to secure axial fire aft for all three. The letter also directed attention to the supposed inferiority of American to foreign guns; to the question of the normal waterline and the depth of the armor belt; and to the overdraft of battleships already constructed.

We have before us a draft of the digest of the proceedings of the Conference, which the Acting Secretary of the Navy has issued for the enlightenment of the public upon this sadly confused question; and we must confess that, after a careful reading of the resolutions adopted by the Conference, we are impressed with the completeness with which it rejected the most important of the above-noted criticisms of the "North Dakota." Although the Conference recommended the thickening of the upper casemate armor from 5 to 6½ inches, it must be borne in mind that even this is quite unequal to keeping out large armor-piercing projectiles. Only too gladly would our naval constructors protect this secondary battery with 8 or 9-inch armor, could this be done without exceeding the limit of weight of 20,000 tons imposed by Congress. Commander Key's suggestion to place splinter-proof armor around the uptakes on this deck was adopted, and we think the suggestion is a good one; but this uptake armor would be useless were the 5-inch side armor removed as Commander Key suggests. The 5-inch (now 6½-inch) armor will serve to explode the heavy projectiles, and the splinter-proof armor will then have a good chance to stop the fragments. The suggestion to mount the 5-inch guns on the top of the 12-inch gun turrets is impracticable. The British "Dreadnought" mounts her corresponding guns in this position, and the critics seem to be obsessed by the "Dreadnought." But the fact that she mounts 12-pounders upon her main turrets is no guarantee that the far heavier 5-inch gun would give satisfaction if so mounted. It really looks as though the sea-going officers have, even at this late day, a lingering fondness for the double-deck turret idea. This, by the way, was one of their own suggestions, and it now has the distinction of being the most serious blunder ever committed in the arming of our ships.

Although the Conference decided that the 5-inch guns, if mounted on the gun deck, could not be fought under certain conditions of weather, the Conference perfectly well understood that this is the principal position in which they *must* be mounted, if they are to be carried at all. The Japanese, Germans, and Russians carry these guns on the same deck. They cannot be mounted on the main deck, since they would be in the way of the fire of the 12-inch guns; and, if carried at a higher elevation, it would involve a serious increase in weights, and greatly complicate the question of the stability of the ship.

In addition to the recommendations regarding the 5-inch battery, the Conference recommended that means of refrigeration be applied to all magazines; that two fire-control masts, similar to those tried on the "Florida," be installed; that ventilating pipes and funnels be kept as low as possible; and it also made minor suggestions regarding the location of searchlights, the provision of bridge facilities for navigation, and the arrangement of torpedo-control stations.

The Conference decided that the 45-caliber guns now afloat in our navy are equal to the latest 12-inch guns afloat in the British navy, and that no change in the number and type of the main battery guns of the "North Dakota" and "Delaware" is desirable at present. In regard to the much-debated position of waterline armor, the Conference decided that the lower edge of the armor should be placed with reference to that waterline at which the ship is most likely to float when engaging in battle. It decided that this most probable waterline is that at which the ship would float with full supply of ammunition and two-thirds supply of stores and fuel on board. It was further resolved that the lower edge of the waterline belt should be placed 6 feet below the most probable fighting draft as defined by the Conference, and that the lower edge of the armor belt of the "North Dakota," being within a few inches of that line, is substantially correctly placed.

Perhaps the most reassuring to the general public of the resolutions adopted by the Conference as to the excellence of our battleships, is the following: "Resolved, That the votes of the Conference upon resolutions based upon several characteristics of the design of the 'North Dakota' are not to be considered in any way as adverse criticism of the design of the 'North Dakota' as a whole, as it is recognized that material sacrifices of weight and space have to be made in order to place five two-gun, 12-inch turrets on the middle line and to attain a speed of 21 knots, which should give an offensive 12-inch broadside fire to the 'North Dakota' equal to that of any other warship afloat or known to be designed at the present time. Passing from the consideration of specific minor defects, the Conference believes that the design of the 'North Dakota' and 'Delaware' is an excellent one. The Conference recommends, that the present arrangement of turrets of the 'North Dakota' be adhered to in the 'Florida' and 'Utah.'"

Limitations of space prevent our notation here of other resolutions, which recommend that the thickness of the belt and casemate armor of the "Florida" and "Utah" be the same as on the "North Dakota" and "Delaware"; and that to carry out the President's instructions to "submit recommendations for the 'Utah' and 'Florida' that will involve practically no delay in their plans," the Conference recommended that the designs of the "North Dakota" and "Delaware" be accepted for the "Utah" and "Florida," subject to certain minor modifications.

It is significant that in spite of the fact that the plans for the "North Dakota" and "Delaware" were approved eighteen months ago, and that many advances and improvements in naval material and ideas have taken place during that period, these plans were approved after a most searching examination and criticism by naval officers, and were found to be so far satisfactory that they were adopted with minor modifications, for our two latest ships, the "Utah" and "Florida."

A significant tribute, furthermore, to the good work being done in our Bureau of Construction is the fact that the latest designs for ships of the "Dreadnought" type by foreign naval constructors show a strong tendency to copy the leading characteristics of our two "Dreadnought" classes, the "South Carolina" and the "Michigan." We refer to the placing of all guns on the center line of the ship, and arranging them in pairs, so that the guns of one turret may fire above the roof of the adjoining turret. A reference to the drawings of recent battleships, as published in our later articles on the Leading Navies of the World, will show how widely this distinctly American plan is being followed.

DETECTION OF SULPHUROUS ACID IN FOODSTUFFS.

Commercial gelatine sometimes contains sulphurous acid, which may be detected and estimated as follows: 20 parts by weight of dry gelatine are immersed in 500 parts of water in a glass flask. After standing 12 hours the flask is heated on a steam bath until the gelatine is dissolved. To the neck of the flask is fitted a cork through which pass three glass tubes. The first tube, which extends to the bottom of the flask, is connected with a carbonic acid generator. The second tube ends immediately beneath the cork and is connected with a Will's tube fitted with a solution of iodine and potassium iodide (5 parts iodine, 7.5 parts potassium iodide, 1,000 parts water). The third tube dips below the surface of the liquid in the flask and bears a funnel, provided with a stopcock. The stream of carbon dioxide is first allowed to flow through the unheated apparatus for ten minutes. The flask is then heated to a temperature not exceeding 158 deg. F., and 25 parts of a 10 per cent solution of phosphoric acid are introduced through the funnel.

The sulphurous acid combines with oxygen, derived from the phosphoric acid, and forms sulphuric acid which is carried over to the Will's tube by the stream of gas. The operation is continued for an hour and the sulphuric acid is then estimated in the usual way from the change of tint of the iodine solution. The presence of sulphurous acid in other foodstuffs can be detected by the same method.

Several months we described the method of extracting venom from *Lachesis trigonocephalus*, a deadly serpent popularly known as the lancehead viper, and of preparing the venom for homeopathic purposes. The medical use of lachesis venom was first suggested in the latter half of the last century by Dr. Constantine Hering, and all the venom in homeopathic use up to last year was of his extraction. Hering, in his published writings, repeatedly reiterated that the venom he used for the remedy, Lachesis, was obtained from the *Lachesis Trigonocephalus*, but since there is in the Museum of the Philadelphia Academy of Natural Science a mounted specimen of *Lachesis Mutus*, labeled with Dr. Hering's name, it was supposed by some that the *Mutus* and not *Trigonocephalus* was the variety he employed. In order that both preparations might be available, the venom of a *Lachesis Mutus* (Bushmaster) has now been extracted by Messrs. Boericke and Runyon and prepared for homeopathic use.

ENGINEERING.

In a paper read before the Society of Naval Architects and Marine Engineers, Henry Penton states that the oldest iron ship in the world is the United States warship "Michigan," the material for whose construction was "dragged across the mountains from Pittsburg to Lake Erie," where the ship was built, as long as sixty-six years ago.

A cave-in or slide of a portion of the preliminary work on the Gatun dam is causing considerable comment. The Chief Engineer of the Canal Commission, however, states that the mishap is of slight importance, and affords no cause for anxiety as to the stability of the dam itself when it shall be completed.

Our Consul-General to France writes of a rubber-asphalt pavement which is being used in that country. The material is a product resulting from the association of asphalt and rubber. It is said to be more plastic and more adhesive than pure asphalt, and to resist higher temperatures. Experimental work covering a period of six years in such cities as Paris and Lyons has given good results.

With the completion of the vast irrigation works now being carried on by the federal government in our western States, this country will possess three of the greatest dams in the world. The Shoshone dam, with a height of 326 feet, and the extremely short length of 175 feet, will store 456,000 acre-feet of water; the Pathfinder dam, 215 feet high and 226 feet long, will store 1,025,000 acre-feet; while the Roosevelt dam, 284 feet in height and 1,080 feet long, will store 1,284,000 acre-feet. The most notable structure comparable with these is the Assouan dam, which, after the work of increasing its height has been completed, will impound 1,860,000 acre-feet of water.

Work is being rushed on the new Ambrose channel, which is to form the entrance to New York harbor, in order to open the channel as early as possible to a depth of 40 feet for a clear width of 1,000 feet throughout the whole of its length. The finished channel will be 2,000 feet in width by 40 feet deep. In the last report the least depth over the 1,000-foot width is given as 37 feet; but, as a matter of fact, nearly the whole area has already been dredged to the 40-foot limit. Up to the present time, 54,000,000 cubic yards have been removed. Four seagoing dredges are continually at work, and they are expected to complete the channel in about two years from the present time.

The recent trial of the British battleship "Invincible," in which she attained, under reduced power, a speed of 25 knots, was followed by a full power trial in November, when she steamed at the unprecedented speed of 28 knots on a continuous run of eight hours' duration. This is certainly wonderful going for a ship protected with 7 inches of armor and carrying a battery of eight 12-inch guns. It is 9 knots faster than the speed of any battleship now in commission in our navy, and 2 knots faster than the one-mile trial speed of our swift cruisers of the "Salem" type. Moreover, it exceeds by 2 knots and 2½ knots respectively the trial speed of the "Lusitania" and "Mauretania," which are to-day the fastest merchant vessels afloat.

We have before us a photograph of a steam rotary excavator built for digging irrigation canals, which forcibly illustrates the natural aptitude of the average American for mechanics. The machine, which was built by a farmer on his ranch 120 miles from a machine shop, is drawn by a 110-horse-power traction engine, from which it takes its steam for driving two auxiliary engines. It carries a drum, 30 inches in diameter by 30 inches in width, upon whose face is a series of 4-inch cutters, which are driven at a speed of 450 revolutions a minute. The excavated material is thrown forward upon a cross conveyor, which delivers at the desired height or distance from the canal. Although the machine is crude in construction, it has shown a capacity of 500 cubic yards an hour in hard soil, and of about 1,000 cubic yards in soft unpacked soil. The cost of operation works out at $2 an hour.

The Boston elevated railroad had not been many months in service before it was discovered that the rails on the curves were wearing out at an astonishingly rapid rate. The tracks were first laid with Bessemer rail having the low percentage of 0.45 of carbon; and, after about three months of service, these rails, where they were laid on curves, were so greatly worn that they had to be replaced. In 1902 some experimental manganese rails were laid on a curve of 82 feet radius; and these rails remained in service until August of the present year. A comparison of these rails with the Bessemer rails shows that the latter wore down 0.065 of a foot in forty-four days, whereas the manganese steel rail wore down only 0.046 of a foot in 2,291 days. According to Mr. H. M. Steward, the company have tested other kinds of rail, made specially by the Bessemer or open-hearth process, including some of nickel steel; but none of these approaches the manganese rail in wearing qualities.

ELECTRICITY.

An electric charging launch has just been built as an auxiliary to the electric yacht "Cascapedia," so as to increase the radius of action of the yacht, and make it independent of shore charging stations. The launch, which is named the "Kilowatt," carries sufficient fuel to enable her to be operated 100 hours, and during this time she can recharge the yacht about a dozen times. This is the first electric auxiliary launch ever built.

Permission has been applied for by the New York, New Haven & Hartford Railway to electrify the Harlem River and Portchester Railroad. This line runs through Mott Haven to New Rochelle, where it joins the main line. The fact that this line is to be electrified indicates that it will be used for extensive passenger service, as it would be hardly worth while to change to electricity if freight is to be the principal traffic.

The Austrian government intends to electrify its mountain railways, and has been studying the question of hydro-electric plants in Scandinavia. According to a report recently made to the government, Norway has a total water power of 28,000,000 horse-power, Sweden 10,000,000 horse-power, and Finland of 4,000,000 horse-power. The plants of these countries now in operation or under construction have a total capacity of 500,000 horse-power.

Ten thousand electric flatirons are to be loaned to reliable customers of the Chicago Edison Company for a period of six months. The object of this is to popularize the use of electricity in the household, and lead to the introduction of other electric utensils. While these irons are loaned out for six months only, it is intimated that if the plan proves a success, they may be permitted to remain in the hands of the consumers for an indefinite length of time.

An interesting example of the displacing of steam by electricity is to be found in the up-to-date laundry. The electric motor is used to provide an individual drive for the various machines. The principal advantage of electricity over steam in this particular application lies in the fact that many of the machines are idle for a large part of the time, and the driving motor of such machines need only be consuming power when its services are required. In addition to this, greater variations of speed are possible with the electric motor, and the machine may be driven at exactly the speed desired. No overhead shafting or belts are used, thus doing away with the dust and dirt that accumulates in the steam laundry.

The street sweepers that operate at night on the more important boulevards of Chicago have found their work hampered and rendered dangerous by the carriages and automobiles that throng these avenues. In order to relieve this danger, each man is now provided with an electric lamp, which is attached to his helmet. A 2-volt 6-ampere tungsten lamp is provided, and this is fed from a storage battery in the sweeper's hip pocket. The entire outfit weighs less than a pound, and the lamps will burn for ten hours without recharging. The sweeper does not have to give the apparatus any care, as it is properly connected up and fitted to him when he starts out to work at night, and needs no attention until he returns from work in the morning.

The use of axle lighting systems in railway cars has reached a greater perfection in England than in this country. Of the 30,000 cars thus equipped in England by a single company, none is provided with any auxiliary system of lighting. This fact makes it imperative that every attention be paid to the electrical equipment to keep it in order. In this country we do not show sufficient confidence in electric lighting systems to depend upon them alone. Other forms of light are invariably used with the electric lights, and the former are apt to be better cared for, because their operation is better understood by the unskilled workman. In England the axle car lighting system is so standardized, that each road makes repairs in any of the cars of a foreign road that may happen to run over its lines.

Some time ago a magnetic phonograph was invented, which the inventor hoped to use in connection with the telephone to receive and record messages in the absence of the owner of the phone. The objection to this system was that a person calling up a number and receiving no response was not inclined to deliver his message to something so intangible as an unresponsive and apparently inanimate machine at the other end of the wire. The daily press reports a new improvement along this line, in which a phonograph is provided to answer calls of telephones when the person called is out. The person before leaving will deliver a message to the phonograph stating when he will return, where he is going, or where he may be called, and this the phonograph will automatically repeat twice to each call. This it will do, no matter how many calls there may be.

SCIENCE

Dr. Charcot, the French explorer who is on his way to the South Polar regions, left Buenos Ayres on November 27.

Mme. Curie, who with her husband, the late Prof. Curie, discovered radium, has been appointed Chief Professor of Physics in the Faculty of Sciences, Paris University. Mme. Curie succeeded her husband in the professorship held by him in the Faculty of Sciences before his death.

Mr. Horace H. Poole has recently determined the heat evolved by pitchblende by means of a delicate thermocouple. With 560.7 grammes of pitchblende in an atmosphere of nitrogen, the temperature steadied at 0.0092 deg. C. above the surroundings. This corresponds to a heat leakage of 0.053 calorie per hour. Hence the amount per gramme per hour is 0.000094 calorie. The amount expected from the radium present is about half of this.

A German patent specification describes a process for preserving milk by removing all dissolved oxygen by means of the addition of a small quantity of ferrous carbonate. The process is based on the fact that freshly precipitated ferrous carbonate in the presence of oxygen immediately assimilates oxygen and evolves an equivalent quantity of carbon dioxide. One part of ferrous carbonate is sufficient for 50,000 parts of milk, and the properties of the milk are not altered in any way by the addition, which should be made before the milk is boiled.

Dr. Otto Rosaner recommends the employment, in soapmaking, of fatty acids distilled in copper vessels, and asserts that every large soap factory would find it profitable to install a distilling apparatus. The fatty acids subjected to distillation should be free from water and should not contain more than 5 per cent of neutral fat or more than 1/5 per cent of ash. These requirements may be satisfied by washing the crude fat with dilute sulphuric acid, in order to separate the fatty acids, and treating the latter, after their separation, with concentrated sulphuric acid. In most cases the distillation may be conducted at temperatures between 450 and 480 deg. F. Distillation in two stages is recommended in preference to continuous distillation, as it both increases the quantity and improves the quality of the product.

A Swiss patent has been granted to a Berlin firm for an explosive mixture composed of sulphur, sodium nitrate, small quantities of potassium nitrate and a chromate, and a carbonaceous material of fatty or resinous character which melts between 85 and 400 deg. F., becomes plastic and adhesive when heated, and is impervious to water. These ingredients are thoroughly mixed, without the addition of water, and are subjected to high pressure and temperature. The explosive is fired with a fuse, like gunpowder, to which it is claimed to be superior in the following respects: The products of combustion are less voluminous, less irritating to the lungs, and settle more rapidly; the explosive never becomes moist, cannot be ignited under 660 deg. F., burns more quietly, is less sensitive to blows and shocks, and possesses greater explosive power. The same firm has patented a safety explosive composed of ammonium nitrate mixed with one-fifth its weight of dinitro or trinitro compounds of the aromatic series, dissolved in a suitable medium. Potassium nitrate may be substituted for ammonium nitrate and metallic powders may be added to increase the explosive action.

Since Prof. Leduc, of Nantes, read his paper at the annual meeting of the British Medical Association, in 1907, on ionic medication, a great deal of work has been done on this subject in England. Prof. Leduc proved the efficacy of this method of local application of drugs by a striking experiment. He soaked a pad of lint in strychnine solution and strapped it to the ear of a rabbit. He then passed a current through the wet pad and the rabbit's ear, with the consequence that a rapidly fatal result occurred from strychnine poisoning. Ionic medication, or cataphoresis, has now been applied to the treatment of various conditions—skin affections, warts, ringworm, sciatica, and rheumatism. The treatment of rodent ulcer by zinc ions has been very successful. Among the cases already reported may be mentioned a case of rodent ulcer in the University College Hospital, which was treated by zinc ionization in the following manner: The ulcer, which was about the size of a threepenny piece and situated on the chin of an elderly man, was thoroughly treated with a solution of sulphate of zinc, then covered with lint soaked in a similar solution, and a positive zinc electrode applied to the lint. A moderate current was then passed through the lint and ulcer for some ten minutes, as a result of which the malignant ulcer rapidly healed. Copper ionization has been tried with success in the treatment of ringworm. Salicylate of sodium and iodine have been used in this way for sciatica.—New York Medical Journal.

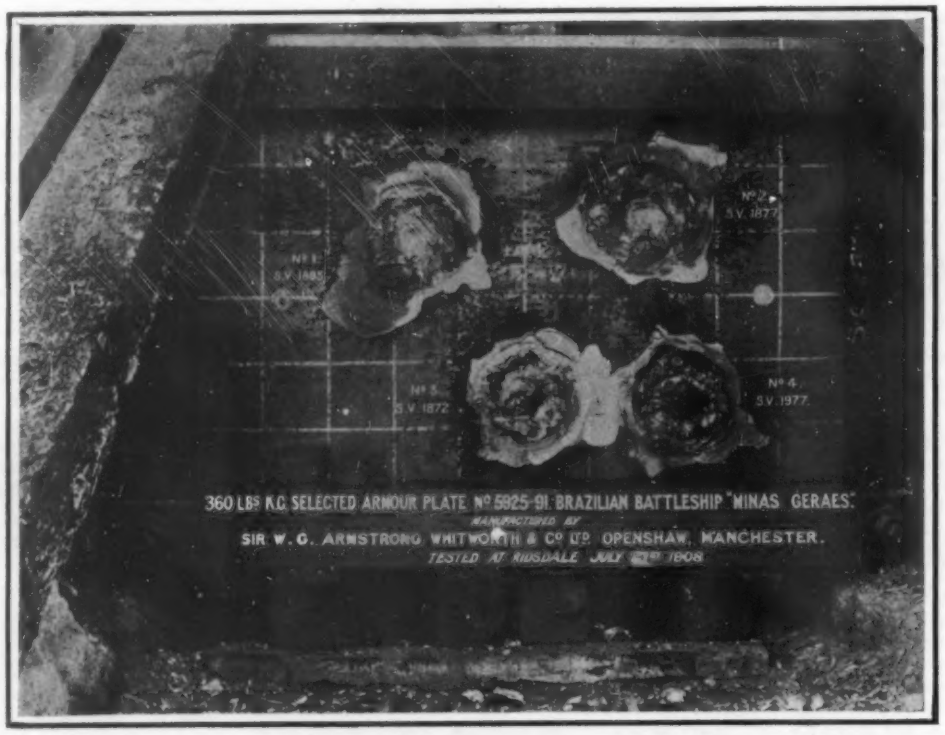
BRAZILIAN BATTLESHIP "MINAS GERAES"—MOST POWERFUL FIGHTING SHIP AFLOAT.

It is a curious anomaly that the most powerful fighting ship afloat should belong to a South American republic. The fact that this ship will fly the Brazilian flag is due to the reorganization of their navy, which is now being undertaken by the Brazilian government. Originally it was their intention to build three battleships of moderate displacement, supplemented with a few armored cruisers, scouts, and destroyers. The events of the Russo-Japanese war, however, and the construction of the British "Dreadnought" led the authorities to greatly modify their plans, by discarding the armored cruisers and putting the contemplated expenditure into three great battleships, which should embody the latest developments of naval construction. The working out of the plans were intrusted to the Elswick firm, who designed the fine ship which forms the subject of our front-page illustration. A sister ship is now under construction by Messrs. Vickers' Sons & Maxim at Barrow-in-Furness.

The principal dimensions of the "Minas Geraes" are as follows: Length 500 feet, breadth 83 feet, and displacement, on a normal draft of 25 feet, 19,500 tons. The vessel will be driven by reciprocating engines at a speed of 21 knots. She will be able to stow 2,000 tons of coal in her bunkers; and arrangements have been made for the storage also of several hundred tons of oil fuel in her double bottom.

The armor protection is very complete. It consists of a belt 9 inches in thickness which extends from stem to stern, being slightly tapered toward the ends. This armor, throughout the length of the citadel, is carried to the upper deck, and affords an unusually complete protection to the broadside battery of 4.7-inch guns. In addition to protecting the secondary battery, the side armor will prevent the entrance of shells below the gun deck, on which fourteen of the 4.7-inch guns are mounted, and its association with a protective deck carried slightly above the waterline will insure excellent protection to the machinery, boilers, and magazines. A novel feature in the protection is the provision of an extra thick steel deck above the central citadel. In addition to the fourteen 4.7-inch guns on the gun deck, eight of the same caliber are carried at a higher level on the superstructure, where they are mounted behind shields and are otherwise protected.

The most interesting feature of the ship is the unusually heavy main battery, which consists of no less than twelve 12-inch guns mounted in pairs in six barbettes. Four of these guns are mounted forward of the superstructure, four aft, and two on either beam. The mounting of the forward and after guns is similar to that adopted in our own "South Carolina" and "Michigan," four of the guns being mounted in twin-gun turrets on the upper deck, and the other four being carried at a sufficiently higher level to enable them to swing clear of the roof of the upper deck turrets, as shown in our illustration. The two remaining turrets are mounted well out on either beam amidships, the superstructure forward and aft being cut away so as to permit their guns to fire parallel with the axis of the ship. This arrangement allows an end-on concentration of fire, which is much greater than that of any other ship of the "Dreadnought" type except the German vessels of the "Nassau" class, the concentration of fire being as follows: Ahead and astern, eight 12-inch and six 4.7-inch; upon either broadside, ten 12-inch and eleven 4.7-inch. These figures are interesting for comparison with the broadside fire of other ships of the all-big-gun type. Thus comparing merely the guns of the main battery, the British "Dreadnought" can concentrate six 12-inch ahead, six astern, and eight on the broadside. Our "North Dakota" can fire four ahead, four astern, and ten on the broadside. The Japanese "Aki" can concentrate two 12's and four 10's ahead or astern, and four 12's and six 10's on the broadside. The German "Nassau" can fire eight 11-inch ahead or astern, and twelve on the broadside. The 11-inch, however, is a much less powerful piece than the 12-inch carried by the Brazilian ship, whose end-on fire must be considered as more powerful, and her broadside of about the same power as that of the "Minas Geraes."


360 LBS K.C. SELECTED ARMOUR PLATE No 5825-91 BRAZILIAN BATTLESHIP "MINAS GERAES"
MANUFACTURED BY
SIR W.G. ARMSTRONG WHITWORTH & Co LTD OPENSHAW, MANCHESTER.
TESTED AT HOUSDALE JULY 21st 1908
No 2 S.V. 1877
No 1 S.V. 1885
No 3 S.V. 1872
No 4 S.V. 1977

RESULTS OF THE ATTACK OF ARMOR FOR THE "MINAS GERAES" BY FOUR 9.2-INCH ARMOR-PIERCING PROJECTILES. MAXIMUM PENETRATION, 3 INCHES. NO CRACKS. PROJECTILES BROKEN UP.

The 9-inch armor was fabricated by the Krupp process, and it will be seen from the accompanying illustration, showing the results of a test of one of the plates at the proving ground, that the armor is of exceedingly fine quality. The attack on the plate was made by a 9.2-inch gun, firing 380-pound Firth shells, three rounds being fired at a velocity of not less than 1,850 foot-seconds from a distance of a little under 100 yards. The first shot, which struck with an energy of 9,497 foot-tons, was completely smashed against the plate, the penetration being very slight, and no cracking of the plate being apparent. The second shot penetrated about 2 inches without being able to crack the plate; and the third, which struck the lower part of the plate in the center, failed also to produce any cracking, and merely served to shake out of the plate the points of the other shots which had become imbedded. The plate was accepted on the strength of these results, but it was determined to give it an additional and more severe test, by firing one more shot at a velocity of 1,977 feet per second and an energy of 10,312 foot tons. This severe test also failed to crack the plate; the penetration was not over a few inches, and the

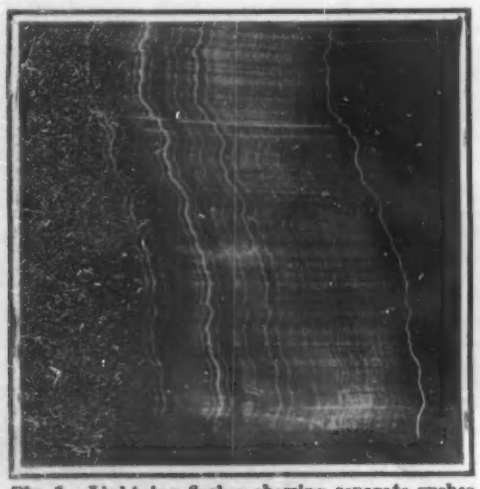
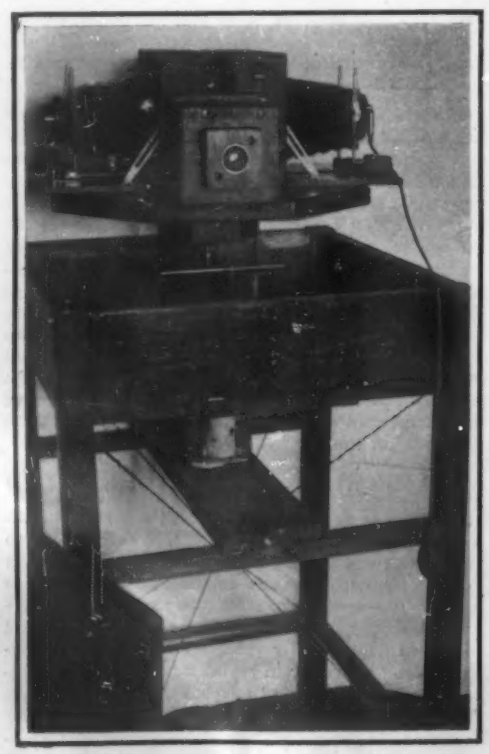


Fig. 1.—Lightning flashes showing separate rushes and black discharge.

Fig. 4.—Spectrum of a spark from a static machine.



Moving camera apparatus for photographing lightning flashes.

Fig. 2.—Lightning flash showing long interval between rushes.

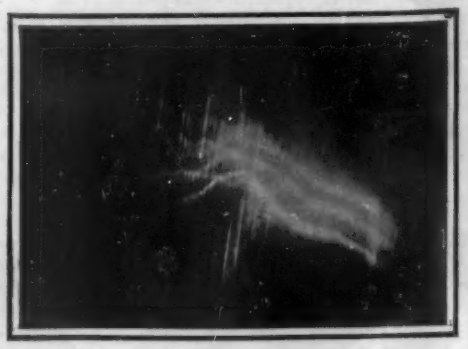


Fig. 3.—A spectrum photograph of a lightning flash.

NEW DISCOVERIES ABOUT LIGHTNING.—[For description see page 430.]

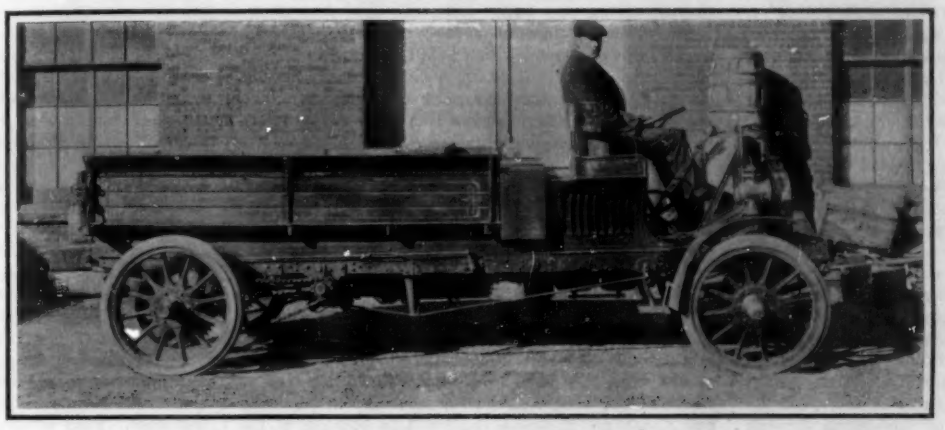
point remained imbedded in the plate. The maximum amount of bulging at the back of the plate, in the line of points of contact, was not over 1.5 inches.

A HYDRAULIC DRIVE SYSTEM.

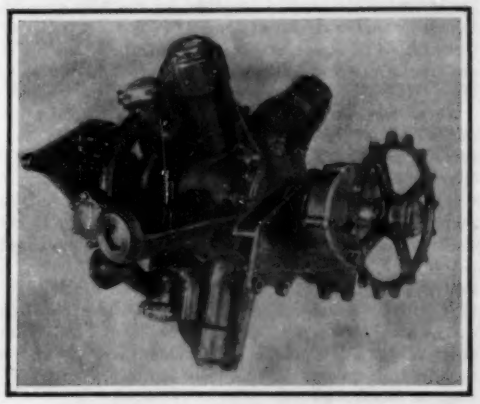
The fact that the internal-combustion engine depends upon momentum of its moving parts to bridge the gaps between explosions, makes it impossible to start the engine under load, and materially lessens its efficiency as its speed is reduced under load. For this reason it is necessary to provide clutches and variable speed gears, which will permit of reducing the speed at the point of application of the power, while the engine itself operates under such a speed as will yield the highest efficiency. A perfect mechanical variable-speed gear has yet to be discovered, and so far we have been obliged to worry along with systems, so abhorrent to the mechanical engineer, of operating by jerks from one speed to another. From time to time efforts have been made to overcome the difficulty by the use of a flexible medium such as electric or hydraulic drive, between the gasoline engine and the point of application of the power. But, hitherto, the operation of these systems has not been such as to warrant their commercial application.

A new system has just been developed by Charles M. Manly, who is probably best known for his work with the late Samuel P. Langley in the development of an extremely light gasoline motor for use on the Langley aeroplane. Mr. Manly's transmission is hydraulic; but oil is used instead of water, because of its lubricating and non-freezing qualities. The oil is circulated in a closed cycle by means of a pump driven directly by the internal-combustion engine, and in the oil circuit one or more motors are included, which are located where the power is to be applied and which are driven by the circulating oil. The key to this system lies in a special form of double eccentric, the throw of which may be varied from the central or zero position, in either direction, so as to vary the stroke of the pistons to any degree within the limits of the mechanism.

In the accompanying illustrations we show the drive system as applied to the operation of an automobile truck. The pump which circulates and generates the pressure in the oil is indicated at *A* in the diagram, while one of the motors, of which there are two, one for each of the rear wheels, is indicated at *B*, the other being removed for clearness. It will be observed that the drive system does away with all gearing between the engine and the wheels, with the exception, of course, of sprocket and chain connections between the motors and the wheels. The differential gearing and the brake are done away with, as well as all variable-speed devices. A single lever controls the stroke of the pump pistons, and the pressure of the oil being directly dependent upon the pump stroke, this controls the speed of the wheel motors, and consequently of the truck. The engine may be run continuously at full speed, in fact there is no necessity for changing it for any purpose; setting of the eccentrics in the no-throw position brings the pump to rest, when its stationary pistons will completely block the circulation of the oil, preventing the motor from operating, and thus providing an efficient brake. As the motors are connected "in parallel," to borrow an electrical term, differential gearing is unnecessary, for they will adapt themselves to the variations in load on the two wheels, as the car is rounding a curve; in fact, there can be no more perfect differential system. The advantage of this drive for use on trucks is that it does away entirely with all complicated mechanisms that would require a skilled operator. The truck shown in our illustration is loaded with sand to a weight of 9,000 pounds. It has been in constant use under this load, and under the most exacting road conditions, for over a year, and always in the hands of unskilled operators. The Manly Drive Company keeps this truck so loaded for testing and demonstrating, and frequently brings in a load of an additional ton or two of material over the roughest kind of roads without troubling to remove the dead weight always carried. For this purpose a small gasoline engine, formerly used in a runabout of 16 nominal horse-power, is amply sufficient. Motor trucks now in use for similar work require a 30- or 40-horse-power engine. Makers will admit that for a gross weight of say 10 tons, a speed of 6 miles per hour, grades not to exceed 5 per cent, and average road conditions, the drawbar pull requires only one-fourth to one-third of that power, but the balance is necessary for reserve, especially for starting on up grades. The great advantage of the Manly drive is that the available power can be increased inversely as the speed, the maximum torque being available exactly when it is most needed in starting from rest without increase of engine power, and the maximum engine power being required only under the most favorable conditions, i. e., under the maximum speed of the car or truck with radiator and circulation giving their maximum effect. This is just what is least possible with drive systems at present in vogue for gasoline automobile use, as is evident to anyone who has tried to start his car up a steep grade. The engine must be run up to speed to attain its efficiency, the brake cautiously released to avoid running back, and the clutch as cautiously engaged, even if there be no necessity for a change of gear in such a situation, all of which difficulties are eliminated by the Manly drive on account of the above-mentioned features and the absolute braking effect of the oil under pressure in the system whenever the pump is even momentarily stationary.



A 5-ton motor truck fitted with a hydraulic drive system.



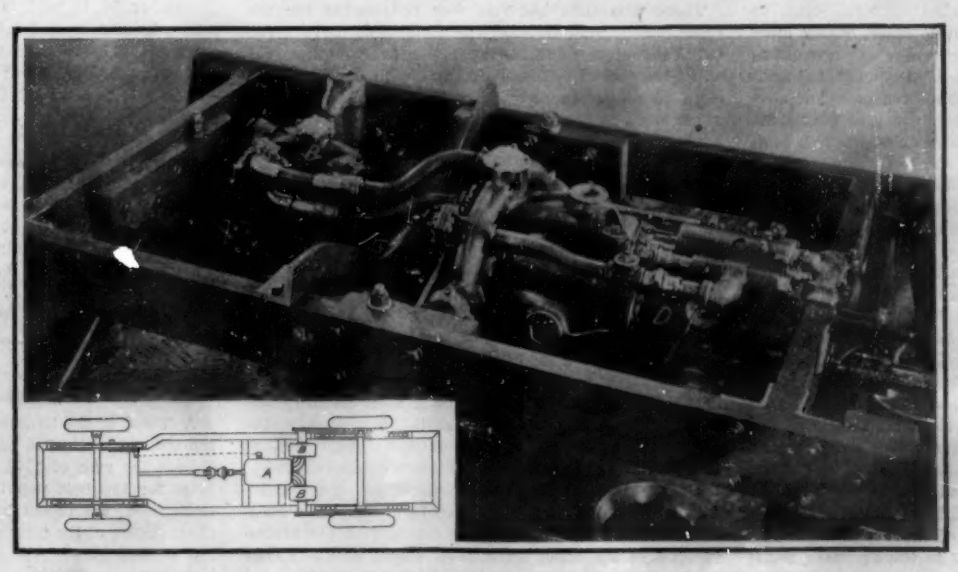
The hydraulic engine. An engine drives each wheel.

In the demonstrations made for the SCIENTIFIC AMERICAN, the bulky motor truck with its 9,000-pound load was backed and maneuvered into and out of close corners, both in the yard and in crowded street traffic, with the utmost ease and quiet, and none of the starting and stopping of engine, engagement and disengagement of clutch, and screech of changing gears, so noticeable when an automobile merely draws up to a sidewalk in a crowded street, while quick changes from full speed ahead to reverse were made, which, with the momentum accumulated by the 20 tons gross of car and load, would have torn the teeth out of any known system of change-speed gear.

The driver of the truck, who is shown in the photograph, has never driven an automobile, and would not know how to drive one. All he knows about the auto truck is that when he moves the lever forward, the truck will move forward at a speed proportionate to the position of the lever; that on bringing the lever back to central position, the truck will be brought to an absolute standstill without requiring any brake; and that on further withdrawing the lever, the truck will move backward in the same proportion. It is obvious that the alteration of the throw of the eccentric must be against the pressure of the oil, which would be a laborious and sometimes impossible operation if the actual movement of the parts were effected by the manual lever. This is overcome by the introduction of an ingenious device, by which the oil pressure itself changes the eccentric throw. The hand lever operates only a pilot valve, the casing of which is shown at *C*, admitting oil from the circulation to the eccentric-operating mechanism, and returning to a neutral position when sufficient movement of the latter has been made.

During the entire year of operation, the hydraulic drive system of the truck has required no repairs whatsoever. The mechanism was provided with adjustments, so as to take up any wear of parts, but so little wear has resulted, due largely to the lubrication of the oil circuit, that, in the machines now building, no such provisions for adjustment are considered necessary. The only attention the hydraulic system requires is that at the end of each week a pint of oil must be added to replace the oil lost by friction in the stuffing boxes.

The possibilities of this system for trucking are very alluring. Instead of gasoline engines, kerosene engines could be used. Heretofore, kerosene engines have failed for automobile work, because they do not permit of the variations in speed that are possible in gasoline engines. A number of these automobile trucks could be started from a central station by a skilled man, who would see that the engines were in proper working condition. Once the engines were started running, they could be left in operation the entire day. An ordinary truckman could then drive the machine without giving thought to the engine, his only attention being devoted to the steering wheel and the single lever that controls the starting, stopping, and reversing of the machine. A truckman would be much better fitted for this work than the skilled chauffeur, because he would know better how



Top view of the hydraulic drive, showing control valve (C) pressure pump (A) and one engine (B), assembled in truck chassis.

A HYDRAULIC DRIVE SYSTEM.

to handle cases, where to go for freight at the docks, how to thread his way through congested streets, and how and where to deliver the load, for which work, moreover, the operator sufficiently skilled to control the complications of the present automobile engine is either too expensive or considers himself superior. A single man could have entire control of the running of the machine and the handling of the freight, whereas in ordinary systems a skilled driver is necessary in addition to the usual freight handlers. In case of an accident to the machine, word could be sent to the central station, and a second truck could be sent out to replace the injured one, while the latter was being repaired.

Although we have shown this hydraulic drive system as applied to auto trucks, it will be evident that it is equally applicable to high-speed automobiles. It is not necessary for a man to be a machinist in order to run an automobile thus equipped, because the usual trouble-making gearing is entirely dispensed with, and the possibility of a break is extremely remote. Mr. Manly has suggested that the system could be used in connection with any power system, in which a variable speed is desired. On ocean steamers, for example, the hydraulic power transmission between the engines and the propeller would prevent racing of the propeller when it was lifted out of the water, for the reason that the incompressible oil circulating through the system determines positively the rate of motion of the various parts, and absolutely prevents the pistons from moving at a higher speed than is set by the circulating oil, even when the load is suddenly relieved.

NEW DISCOVERIES ABOUT LIGHTNING.

BY JAMES COOKE MILLS.

While photographs of lightning flashes are not new, such pictures as recently have been taken under the auspices of the Smithsonian Institution are attracting unusual attention in the scientific world. Curiously enough, the investigations which have been conducted along this line were brought about almost by chance. A year or so ago, a letter was received by the secretary of the Smithsonian, inquiring for a publication of the Institution relating to photographic experiments. It was couched in quaint English and written in a foreign hand, its author being Alex Larsen, who a short time before had arrived in this country from Denmark. In his letter Mr. Larsen mentioned incidentally that he had taken some photographic lightning by holding a small camera in his hand and revolving it from side to side. He inclosed a proof of one of his pictures, and inquired if it was of any scientific value.

The idea of taking pictures of lightning with a moving camera, while not new to the officials of the Institution, was considered by them well worth experiment. They opened a correspondence with the young investigator from Denmark, and found that he was more than ordinarily well versed in science, having made a study of chemistry, physics, and mechanical and electrical engineering in his native land. His material resources were limited, and the apparatus he used was necessarily crude, he having conducted his studies and experiments at odd moments from the daily grind of eking out an existence.

The Smithsonian officials deemed young Larsen worthy of assistance, and they appropriated a grant from the Hodgkins Fund of the Institution for the provision of an excellent photographic apparatus, and a sum of money for the construction of a suitable moving device to continue his experiments, and also to pay in part for his support.

The results of this comparatively small outlay have been notable. The peculiar flickerings of most lightning flashes, which the ancients attributed to some supernatural origin, have now been analyzed, and several successful exposures clearly show that nearly all flashes are composed of several discharges following one another at certain intervals in the path made by the first discharge. It is definitely determined, therefore, that a flash of lightning is not one single vibration, as generally supposed, but is made up of numerous small flashes or "rushes."

How rapidly these rushes must follow each other may be imagined from the fact that the flash may be composed of as many as forty rushes, and the duration of the whole a fraction less than half a second. The perpendicular flash shows a brown sheet on the negative, and on the prints from that the distinctive rushes can be counted. The time of the flash is determinable from the known width of the sheet on the plate and the known motion of the table on which the camera is set. According to calculations made by Mr. Larsen, the rushes vary in duration from three one-hundredths of a second to two one-thousandths of a second.

The most remarkable result of these experiments is the discovery of a "black rush" in the lightning flash, that is, a rush not discernible to the eye; and as paradoxical as it may seem, there is invisible lightning. To verify and substantiate this, we have only to refer to Fig. 1, a reproduction of a photograph taken September 1 at 9 P. M. The storm during which this flash was photographed began about 7 P. M., with the wind northeast, which is very unusual for Chicago. The wind gradually changed to north and northwest, the temperature being about 24 deg. C., and the barometer varied between 29.89 and 29.92. The flash was obtained when the storm was most severe and while it was raining very hard.

This flash is composed of forty separate discharges, made up of one band, which in all probability is composed of a number of separate rushes or oscillations very close together, and one black discharge. It is this black discharge which makes this flash the more interesting, and the photograph shows it running parallel and on both sides of the first bright rush, the boundary line on the inner side being more plainly marked. From this black discharge issue several side branches on both sides, a large one spreading out over the other rushes quite prominently. These side branches all pointing downward indicate that the black rush was a downward stroke, and they also tend to prove that it must have had a good deal of resistance to overcome. It must have cleared the way for the first bright discharge, which in all probability proceeded from the ground upward. The difference in width of the bright discharge, measured at its lower and upper parts, would confirm this opinion of the experimenter, being nearly twice as wide at the lower part as at the upper part.

An interesting question here presents itself. Have we here two separate discharges with different rates of oscillation traveling the same path? Can such a condition be possible? To the experimenter's mind the most plausible explanation would be that the two discharges occupied two separate paths, one inside the other, one discharge forming, so to speak, a tube through which the other passed. It may also be claimed that the bright discharge is probably part of the dark discharge for some reason rendered more luminous. This explanation may be the true one, although it appears as if the bright flash is entirely separate. The measurements of the width of the lower and upper parts of both discharges confirm this opinion.

Authorities differ in their opinions as to the probable cause of these dark rushes. It has been suggested by some that there really are no black discharges, but what appear as such are excessively bright rushes causing a reversal of the image on the plate. This explanation may be the true one if we understand the word "brightness" to mean increased actinic power of light. In the black discharge represented this chemical effect must have been extremely high, owing to the fact that the smallest hair-like extremities of the side branches are well reproduced on the picture as black, in comparison with the broader and to all appearance more powerful discharges following after.

It was at first thought likely that we had to deal with an interference phenomenon, but the idea was discarded. Then it was suggested that the black discharge was probably due to slow oscillations (the width of it would tend to confirm this), and what appeared as black on the plate would be in reality a dark red discharge on a partially illuminated background. The red, of course, would take black in the photograph. This opinion had also to be discarded for the reason that, if such be the case, the side branches of the dark discharge would have been obliterated by the other rushes following. The effect of halation and solarization was also considered, but rejected.

There was thus but one way to account for the prenomenon, namely, that the flash must have given out light of a wave length much shorter than the wave lengths of visible light, and with a power sufficient to render the portion of the plate struck by it non-sensitive to ordinary light. Such a flash would appear black on a partially illuminated background, or be invisible.

Dark flashes have been observed by the experimenter on several ocasions, and only when raining very hard. They appear to the eye the same as the accidental image produced after looking at a bright flash. Such an image may be retained in the eye for quite a while, but cannot easily be confounded with a real flash.

Fig. 2 was obtained on October 1. We have here a flash composed, first, of two bright discharges close together, then there appears to be an interval of about a fourth of a second, which in all probability was filled in with a number of fainter oscillations (the lines running across seem to indicate that), and at the conclusion of the flash are four bright rushes.

During the summer a new departure was undertaken by Mr. Larsen, the object being to obtain spectrum photographs of lightning. Spectroscopic examinations of lightning have been made by many, but most of these observations have been visual, which at their best can only be rough approximations of the number of lines and their relative positions. An apparatus was constructed, consisting of a camera with a prism fitted in front of the lens, no slot being used, as a lightning flash is a relatively narrow streak of light yielding a practically parallel beam. By means of this arrangement a few photographs have been obtained, one of which is reproduced in Fig. 3, while a spectrum photograph of a spark from a static machine, for comparison, is shown in Fig. 4. The first shows the spectrum of one of those horizontal meandering flashes often seen at the conclusion of a storm of long duration. It differs considerably from the other, several lines being absent. No definite opinion has as yet been offered by Mr. Larsen as to the meaning of the changes of these lines in the spectra of different flashes, because more material must be obtained before a positive statement can be made.

The moving camera apparatus for making lightning flashes is a simple enough device, and has proved satisfactory at all times. A spring motor movement (of the kind used to operate revolving stands for exhibiting goods in show windows) was procured and mounted inside a table specially constructed for the purpose, and a stand for supporting the cameras was fitted to the central shaft.

As the speed of the motor was too slow, the fly-vane shaft was removed and the vane moved to the next shaft, which was lengthened so as to extend under the table. Thus arranged the fly-vane could be made to revolve in a liquid placed in a vessel under the table, thereby preventing much of the vibration and getting a more uniform speed. Fig. 6 shows the arrangement of the apparatus, with the table top removed to show how the motor movement is placed; the fly-vane revolving in the water box beneath. The stand is usually revolved at a speed of one turn in ten seconds, which was found to be the most suitable for ordinary purposes. The reason for employing a motor movement with a uniform speed to move the cameras is to ascertain the exact duration of a flash or the intervals between the rushes.

The amateur photographer who would take pictures of lightning flashes with a moving camera need have no such device to revolve the camera, as it may be moved by hand, being swung from right to left and back again, each swing lasting about a second and covering an angle of 60 degrees, which is also the angle of the lens. An ordinary magazine camera for all ordinary purposes is the most convenient, on account of the rapidity with which the plates can be changed, this being of great importance, because as a rule the time most favorable for obtaining good pictures is very short, seldom lasting longer than from ten to fifteen minutes.

The best way to hold the camera is to place it close to the body, tilting it somewhat upward so as to get as much of the sky in the picture as possible, and swinging the body from side to side. The time and angle of the swing can be regulated with a little practice so as to be fairly accurate. With the utmost care, however, the element of luck enters into the work to a considerable degree, and the game is one of patience and perseverance.

Official Meteorological Summary, New York, N. Y., November, 1908.

Atmospheric pressure: Highest, 30.45; lowest, 29.49; mean, 30.04. Temperature: Highest, 62; date, 26th; lowest, 27; date, 5th; mean of warmest day, 57; date 26th; coolest day, 32; date, 15th; mean of maximum for the month, 50.8; mean of minimum, 38.6; absolute mean, 44.7; normal, 43.8; excess compared with mean of 38 years, +0.9. Warmest mean temperature of November, 50, in 1902. Coldest mean, 37, in 1873. Absolute maximum and minimum for this month for 38 years, 74 and 7. Average daily excess since January 1, +1.6. Precipitation: 0.75; greatest in 24 hours, 0.66; date, 14th and 15th; average of this month for 38 years, 3.43. Deficiency, —2.68. Accumulated deficiency since January 1, —2.39. Greatest precipitation in November, 9.82, in 1889; least, 0.75, in 1908. Wind: Prevailing direction, west; total movement, 9,364 miles; average hourly velocity, 13.0 miles; maximum velocity, 46 miles per hour. Weather: Clear days, 13; partly cloudy, 6; cloudy, 11; on which 0.01 inch or more of precipitation occurred, 3. Frost: Light, 2; killing, 5th. Snow: 0.6. Fog (dense), 10th, 22d, 23d, 24th, 25th.

A $500 Prize for a Simple Explanation of the Fourth Dimension.

A friend of the Scientific American, who desires to remain unknown, has paid into the hands of the publishers the sum of $500, which is to be awarded as a prize for the best popular explanation of the Fourth Dimension, the object being to set forth in an essay the meaning of the term so that the ordinary lay reader can understand it.

Competitors for the prize must comply with the conditions set forth in the Scientific American of November 21, 1908.

Correspondence.

SIR ISAAC NEWTON AND THE APPLE.

To the Editor of the SCIENTIFIC AMERICAN:

In yours of August 22, 1908, you mention an oft-told story about the law of gravitation. I think we all have eyes to see apples fall to the ground, but Sir Isaac had eyes backed up by such a grand brain that he first saw the ground fall to the apple. LAWR. HARGRAVE.

Woollahra Point, Sydney, October 5, 1908.

GEAR-DRIVEN PROPELLERS FOR AEROPLANES.

To the Editor of the SCIENTIFIC AMERICAN:

I should like to call your attention to the defective application of power in the Wrights' aeroplane. I have just read of Wilbur Wright's saving himself from an accident which might have been as serious as Orville Wright's. This should be conclusive proof that chains should be discarded for more positive drive, using gears. Chains cannot be made which can absolutely be depended on not to break, and they do break on automobiles and other pieces of machinery. As Wright has ample power and extra weight would not be an objection, there seems no reason for his not using gear-driven propellers. This would make riding in the aeroplane fifty per cent more secure. Through your columns, which have given such valuable advice to inventors, will you not suggest some such change?

FRANCIS LEE HERRESHOFF.

New York, N. Y., November 19, 1908.

THAT MYSTERIOUS AEROLITE.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of November 28, 1908, under the heading, "The Mysterious Aerolite," Mr. E. B. Hoyte suggests that the explosion heard by Mr. Park Marshall on September 8, at about 10 A. M., was caused by the exploding of a shipment of dynamite, and not by a possible meteor.

That may be the solution of the disturbance, but I think it an interesting coincidence that on September 8 at about 10 A. M., while walking along a street of Winchester, Franklin County, Tenn., I suddenly looked up at the sky, and saw what seemed to be a pyramid of yellowish white flame, on its side, going through the air at a tremendous rate, with the base end foremost. It was as brilliant as the sun at noon on a clear day, but it did not blind my eyes. It seemed to be about three yards long from base to top, and exceedingly high up in the sky. I scarcely had time to see it before it was out of sight. It was going in a northwesterly direction at an unprecedentedly rapid rate.

I immediately told of what I had seen, and had just finished the account when I heard what I at first thought to be thunder out of a clear sky; but when the noise continued to roar and rumble, and cause a slight vibration of the ground, I thought there had been an explosion somewhere. It was not until all explosion theories had been proved false in the vicinity of Winchester, that I connected the noise with what I had seen.

Whether the two had anything to do with each other, I do not know. But the object in the sky and the sound of an explosion have never been satisfactorily explained to my knowledge. A. M. BUTTON.

Waterford, N. Y., November 28, 1908.

THE FLORIDA INLAND CANAL.

To the Editor of the SCIENTIFIC AMERICAN:

Kindly permit me to say a word through your great paper on the subject of an inland canal through the great State of Florida.

I gave twenty-four years of the best days of my life and broke down from overwork, in aiding in the development of Florida. The last work that I did before leaving the State was the completion of surveys to determine the extent of the great bodies of muck land from one foot to six feet under water, along the east coast of Florida, and to see if those lands could be reclaimed, which when reclaimed would constitute a portion, and a large portion, of the richest sugar, rice, vegetable, and tropical fruit lands in the world. Working in co-operation with the great Diston effort to reclaim the muck lands in the Kissimmee Valley and to lower the waters of Lake Okeechobee, which is only nine feet on its surface at low water above sea level.

We discovered by joining these surveys at the headwaters of the St. Johns River with those of the surveys by Mr. Diston from the headwaters of the Kissimmee River, that a ship canal on the sea level carrying a depth of twenty feet of water could be cut, giving a canal almost the length of Florida, by utilizing the St. Johns River, running nearly a hundred miles due north to Jacksonville before it enters the Atlantic Ocean, and by utilizing the lower Kissimmee River and Lake Okeechobee and Lake Hickpochee and the Calachasee River for nearly another hundred miles to enter the Gulf, thus saving millions of acres of some of the richest land on earth on both sides of a canal nearly three hundred miles long, that can be constructed for twenty-five million dollars and insure the drainage of the larger portion of the Everglades without additional expense.

It was by accident or a coincidence of ultimate results that the sea-level route was found. We were planning to open the headwaters of the St. Johns River from near the south end of Lake Washington into the Indian River, the surface of Lake Washington being about twenty feet above Indian River, and the St. Johns at Jacksonville being about ten feet below the surface of Lake Washington.

Noting the peculiarity of the river running nearly on an air line over a hundred miles north, started us to taking a system of levels at its fountain head, and we found that the St. Lucy River found its headwaters in the same lake, running to the Atlantic Ocean in a southeast direction.

By checking up these levels, we found that if we cut a canal through to the Indian River from this lake, we would damage navigation on the upper yet lower St. Johns River.

We found in running lines of level from the south end of Lake Washington to the Kissimmee River t strike the line of the Diston canal for Lake Okeechobee, that the Alpataka Flats was the drainage and dividing line between the east coast and the west coast of south Florida, and that the lowest point across was not exceeding fifteen feet above sea level and only a few miles wide.

Mr. Diston had already opened a canal for small boats through from Kissimmee by way of Lake Okeechobee, Lake Hickpochee, and the Calachasee River to the Gulf, and had run level lines the entire distance. Hence it was only a matter of comparing my east coast survey with his midland and west coast survey, and thus we found the long-looked-for canal route on a sea level that could be made available for ocean-going ships as well as for drainage; and found out also that without lowering the great lake to the sea level it would be practically impossible to drain any great portion of the Everglades, or to keep the water in the Kissimmee Valley from backing up and overflowing the drained lands during extra heavy rainy seasons.

So astonishing was the simplicity of the construction of this canal, that would save and reclaim enough land to produce the sugar and rice consumption for fifty years in America at three cents a pound for sugar at a good profit, and yet so stupendous was the vast field opened for local and national benefit by the construction of this canal, that it startled us; for the hope of a sea-level canal across Florida from the Gulf to the Atlantic had been abandoned years ago after numerous surveys.

This work should now be coupled with the great Inland Waterways Proposition for the canal from Lake Michigan at Chicago to the Mississippi River; and when the two are completed, no ordinary mind can grasp the world-wide benefits that will result from their construction.

On the discovery of the possibility of a sea-level canal that would accomplish this great double purpose, we planned with Mr. Diston to join our work and ask Congress to dig this canal, as it would not only save millions of acres of the richest land on earth, it would give the Gulf of Mexico an inlet and outlet to the Atlantic Ocean and to the eastern world without ships having to pass out of the Gulf over the dangerous reefs, or around Cape Florida over the most dangerous reefs known to American commerce. With the canal from Chicago to the Mississippi, boats both from the East and the West could go down and back through the Caribbean Sea, around the end of Cuba, and out through the Panama canal to the Pacific Ocean, missing nearly all of the most dangerous voyage known to American commerce. S. A. JONES.

Waynesville, N. C., November 8, 1908.

PROGRESS ON THE PANAMA CANAL

A review of the reports of the Isthmian Canal Commission for the fiscal year ended June 30, 1908, shows that most satisfactory progress is being made, the results in excavation exceeding the most sanguine estimates of progress. In order to concentrate authority, to expedite the transaction of business, to secure proper co-ordination, to fix definitely the responsibility in any particular case, and to reduce the cost of administration, a complete reorganization was undertaken toward the close of the fiscal year, to be effected gradually, beginning July 1, by which all construction work, in any given district, irrespective of its character, would be placed under one head, the necessary authority having been received from the Secretary of War for the transfer of duties as between departments, required by executive order of January 6, 1908.

To accomplish the objects sought, the zone was divided into three parts, each of which is to constitute a division under the department of construction and engineering, the division engineers reporting direct to the chief engineer. The first is to include all territory north of Tabernilla, to be designated the Atlantic division; the second is to extend from Tabernilla to Pedro Miguel, to be named the central division; and the third, extending from Pedro Miguel to deep water in the Pacific, will constitute the Pacific division. As the reorganization is not complete at this time, its details must be left for the next annual report.

EXCAVATION AND DREDGING.

This department embraced the Culebra division, the Chagres division, the Colon dredging division, and the La Boca dredging division.

Culebra division.—This division extended from the Chagres River in the vicinity of Gamboa to include the Pedro Miguel lock, a distance of 9.2 miles; the total amount of material excavated in the Culebra division during the year was 12,065,138 cubic yards, place measurement, of which 11,685,253 cubic yards were from the canal prism and the balance for accessory work. The total number of steam shovels assigned to this part of the work during the year was 59.

As practically all the areas suitable for dumps within the limits of the division were utilized to their fullest capacities, the greater part of the material was hauled over the main line of the Panama Railroad to Gorgona and Tabernilla on the north and to the new dumps at Miraflores and La Boca on the south, the average haul being about 10 miles.

On October 4 the Cucaracha slide, which had caused more or less inconvenience since the work was begun by the French in 1884, started to move toward the east edge of the canal at a rate, at first, of 14 feet in twenty-four hours, decreasing toward the close of the month to about 4 feet in the same period of time. About 113,000 cubic yards of material moved so as to effectually stop the transportation of material through the "cut" to the south, and necessitated th handling of all material over the single-track portion of the Panama Railroad via Empire to the south. Work was prosecuted, without interruption, day and night, by steam shovels and improvised hydraulic means, and by the end of the month sufficient space was gained on the moving mass to permit the passage of dirt trains to the south over the old route. The total area of the slide was approximately 34,455 square yards, and it was estimated that about 600,000 cubic yards were in motion. The removal of this slide is not a source of difficulty in the dry season. A wide berm was left with the hope that should rapid movement again take place, steam shovels could prevent the interruption of traffic.

The slide at Paraiso, another which developed when the French were at work on the canal, gave trouble in April of this year. The estimated area is 16,700 square yards, and the amount in motion is about 140,000 cubic yards, of which about 90,000 cubic yards have been removed.

Chagres division.—This division covered a distance of about 23 miles and extended from Gatun to a point where the canal crosses the Chagres River at Gamboa. The river crosses the canal line 23 times within the limits of this division, so that during construction a considerable portion of the prism is subject to overflow by floods, and to such an extent that progress of work is liable to be slow during the rainy seasons.

The surveys reported as in progress in the last annual report were completed, and the center line of the canal permanently marked. Slight changes in the alignment were made in the final location whereby a saving of 1,264,700 cubic yards was effected; of this, 264,300 cubic yards were rock. These surveys show that the total amount to be removed from this part of the canal prism is 12,256,300 cubic yards, of which 8,313,500 cubic yards are earth and the balance rock. During the fiscal year excavation was begun on four different sections. The total amount of material excavated was 1,774,124 cubic yards, place measurement, all from the canal prism. The total number of steam shovels in operation in this division was 15 and the balance of the equipment is largely that left by the French; 47 out of a total of 50 engines in use are French, as are 410 of the 645 dump cars.

Colon dredging division.—This division extended from the foot of Gatun lock to deep water in the Caribbean Sea, and embraced the Mindi and Colon districts and the Cristobal machine shops. Excavation by steam shovels was begun in July, and two of them removed a total of 536,959 cubic yards, including both swamp and rock. Dredging during the year was done by two French ladder dredges, two dipper dredges, the 16-inch suction dredge, and by the seagoing suction dredge "Ancon." A total of 5,087,623 cubic yards of material was removed, of which 4,947,330 cubic yards were from the canal prism and the remainder from accessory works.

La Boca dredging division.—The change in the location of the locks and dams on the Pacific side extended the limits of this division about 3 miles, the area to be dredged extending from the Miraflores locks to deep water in the Pacific, a distance of about 8 miles, with a width of 500 feet. The quantity of material to be removed is estimated at 29,212,700 cubic yards, at least 1,500,000 cubic yards of which is rock. There have been used on this stretch of the canal the seagoing suction dredge "Culebra," which went into commission on January 1, and four French ladder dredges. The dipper dredge was taken out of commission on January 17, 1908, as not suitable for handling the soft material, and will be utilized later in the removal of rock. During the fiscal year a total of 5,273,369 cubic yards was removed, of which 5,264,019 cubic yards were from the canal prism and 9,350 cubic yards from accessory works.

LOCKS AND DAMS.

This department of construction embraced the Gatun locks and the Gatun dam divisions, the Pacific division of locks and dams, and the division of meteorology and river hydraulics.

The locks are in pairs, and since the compilation of the last annual report the projected dimensions have been increased so that the width in the clear will be 110 feet, the usable length remaining, as heretofore, 1,000 feet. The question of increasing the width was raised by the General Board of the Navy, in a memorandum to the Secretary of the Navy, dated Washington, October 29, 1907, setting forth "that the width of the locks as now fixed, namely, 100 feet, is insufficient for probable ships of future construction, and that sound policy would dictate an increase to a clear width of 110 feet."

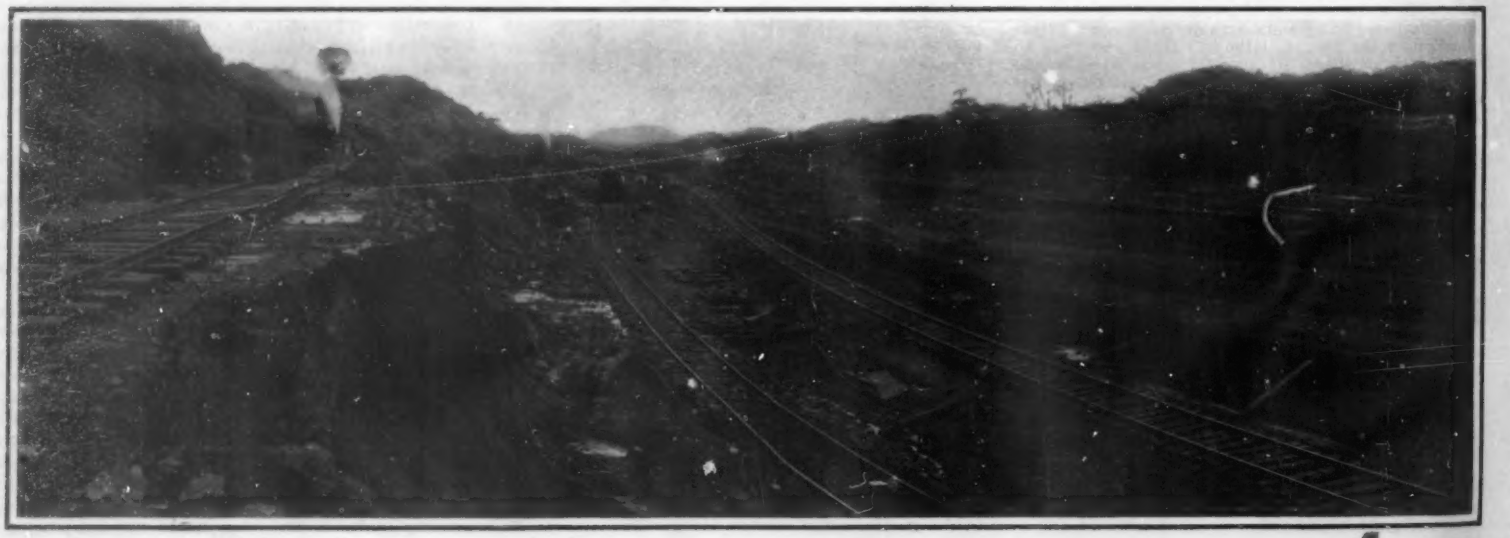
The project prepared by the minority members of the board of consulting engineers for the lock type of canal provided for a flight of three locks at Gatun, a flight of two locks at La Boca, and one at Pedro Miguel. The locks at La Boca were placed on the west side of Sosa Hill, and were to overcome the difference of the level between the ocean and a lake formed by the Sosa-Corozal and the Sosa-San Juan dams. Steps were taken to construct the former of these dams in accordance with the proposed plan, and

Culebra cut, looking south.

The steam shovels load directly into trains which are hauled to distant dumps.

Tenth Street, Colon, before paving.

Tenth Street, Colon, after paving.



Pedro Miguel lock site.

Excavating for the spillway on the center of Gatun dam.

PROGRESS OF THE PANAMA CANAL.

trestles were built along the toes from which to dump material from Culebra cut. The trestles failed after the dumping from them began, and the material overlying the rock moved laterally, carrying the superimposed mass with it. When the unsuitable nature of the ground became evident, a careful examination of the canal route from Pedro Miguel to the Pacific was undertaken, and a study of the data thus obtained led to the conclusion that one lock at Pedro Miguel and two at Miraflores offered the most economical and desirable solution. The advantages of this plan over the then existing project were that dams of lower height, less length, and resting on rock comparatively near the surface could be more easily constructed and could be completed at an earlier date; and finally that the locks in this location would be protected against all possibility of distant bombardment and would be less exposed to gunboat or torpedo boat attack. As a consequence, the commission recommended a change in the project, which received the approval of the President on December 19, 1907.

The designs for the locks are still in course of preparation, but the studies have reached such a stage that the general features will be definitely determined at an early date.

Gatun locks.—Investigations were continued during the year to ascertain the depths of the underlying strata and to determine also whether suitable material extended sufficiently far below the level on which the lock walls are to be built to carry the weight; a depth of 50 feet below this level was fixed and the borings were so made. The materials encountered may be briefly summarized as a layer of argillaceous sandstone, overlying a layer of conglomerate which is composed of pebbles and other hard aggregates held together by a cementing material, and which subsequent excavation shows to be hard enough in texture to require blasting for its removal. The borings disclosed an underground flow through the sandstone, the source of supply being apparently ground water from the hills to the southeast and at a considerably higher elevation than the lock site. It is intended now to prevent access to the foundation of this water by means of curtain walls connected with the underlying impervious stratum of argillaceous sandstone, and additional precautions will be taken if developments during construction make such advisable or necessary.

The excavation for the locks was continued throughout the year. The total amount removed from the site was 1,769,115 cubic yards.

Gatun dam.—Investigations, primarily undertaken to verify data already on hand concerning the character of material for the foundation of the dam, were continued. A test pit, 12 feet square, was sunk in the hill through which the spillway is being cut and near its head, and this has been carried down to about 35 feet below sea level. The rock formation here is practically the same as that at the lock site. On Gatun Island a test pit 20 feet square was sunk to a depth of 68 feet below sea level. Wash borings were resorted to, but care was taken to secure drive samples whenever there were indications of any change in the character of the material.

The examinations made of the spillway indicate that the rock is of sufficient strength to bear safely any of the loads that will be placed upon it. What seepage there is occurs in the top stratum; and though this is small, it is proposed to cut it off by sheet piling projecting up into the core of the dam and down into the impervious layer.

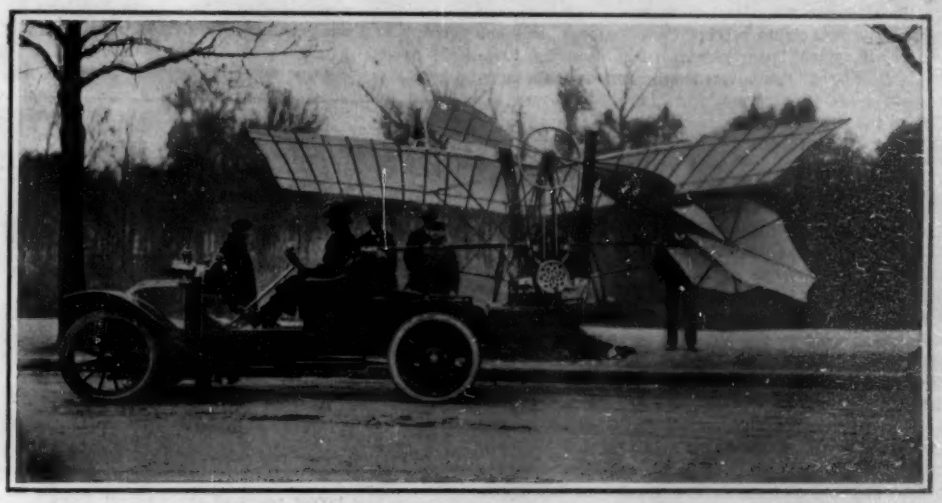
Two experimental dams, with dimensions corresponding to the dam as it is to be built, were made, on the scale of 1 inch to the foot, and these experiments show not only the suitability of the available material, but that a stable and water-tight dam can be built by hydraulic methods. Construction work at the dam during the year consisted in the removal of 918,920 cubic yards of material from the spillway.

Pedro Miguel.—As it was more advisable and economical, the Culebra division excavated the lock site down to reference 40, practically completing it to this grade at the close of the fiscal year, and removed 1,071,696 cubic yards, which amount is included in the total vardage under Culebra division.

Miraflores locks and dams.—It is shown conclusively by test pits and borings that the locks will rest on rock of ample strength to make suitable foundations. A hard limestone is found for the upper part of the site, changing to argillaceous sandstone at the lower end. The borings disclosed no such variations in the formation as exist at Gatun.

Municipal engineering.—The work of this division consisted of the completion of the waterworks, sewerage system, and paving in Panama and Colon, the cost of which is to be reimbursed to the United States through the collection of water rates in those cities, and of the construction of waterworks and sewerage systems, paving, grading, and road making in the Canal Zone. The total cost of the work done was $1,067,150.52.

Work in Panama and Colon, as originally planned, is practically completed.

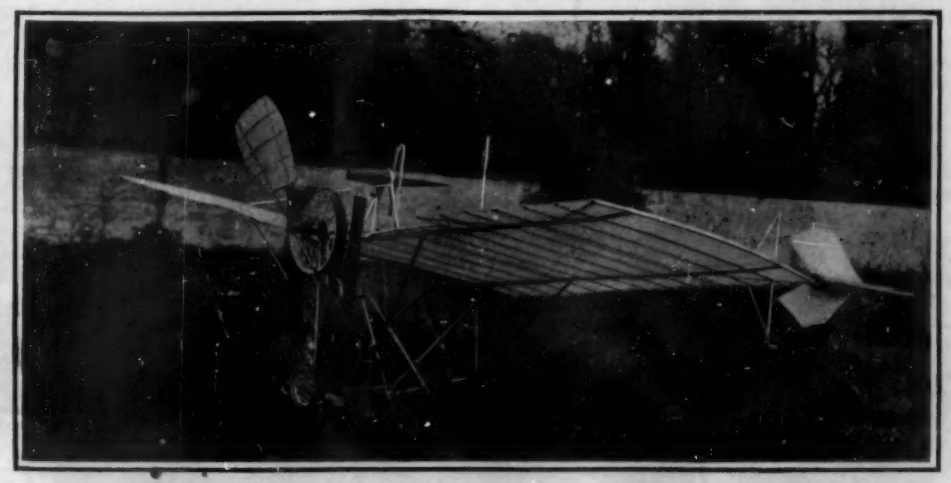


Santos Dumont transporting his new monoplane on his automobile from Paris to his experimental field at St. Cyr.

This miniature aeroplane complete with its 24 horse-power motor weighs only 297 pounds. A speed of about 36 miles an hour must be attained with it on the ground before it will rise in the air.

SANTOS DUMONT'S LATEST AEROPLANE.

The tiny aeroplane illustrated on this page is the latest one to be produced by Santos Dumont. The noted Brazilian experimenter has not been actively engaged in continuing his experiments in aviation for the past few months, but he has now taken up the subject again, and has brought out once more the tiny gravity well below the line of support. The propeller, which is mounted upon a hollow steel shaft running in ball bearings, is placed at the front edge of the plane at the center. It is about 6 feet in diameter, with a 6½-foot pitch, and runs at a speed of 700 R. P. M. The machine as it now stands has a 24-horse-power 8-cylinder Antoinette motor, arranged on a 3-wheeled running gear. The motor drives the propeller by a wide belt. A speed reduction of about one-half is arranged for from the motor to the propeller. The normal speed of the motor is 1,300 R. P. M. Its weight complete is 127.6 pounds. A seat is provided just back of the motor for the aviator, who controls the combined vertical and horizontal rear rudder by means of a vertical wheel placed beside the motor. The entire machine complete in running order weighs only 297 pounds. The spread of the wings is but 5 meters (16.4 feet), the dimensions of each wing being 2.5 x 2.1 meters. The total supporting surface is only 10.5 square meters (113.02 square feet). A speed of about 36 miles an hour must be developed upon the ground before the machine will rise in the air.



The 24-horse-power, 8-cylinder motor drives the large propeller by means of a belt. The motor is mounted upon a 3-wheeled running gear and the aviator's seat is immediately behind it. Note the long vertical radiators on each side of the propeller, the gasoline tank above the wings, and the combined vertical and horizontal tail at the rear.

SANTOS DUMONT'S LATEST MONOPLANE, THE "DEMOISELLE."

This reconstructed monoplane is by far the lightest and most powerful machine of its kind that has ever been produced. With Santos Dumont in the aviator's seat the total weight to be lifted is about 411 pounds, which gives a loading of the single surface of 4 pounds per square foot. This is about the highest ratio of weight to surface that has ever been employed.

On the 12th ultimo M. Dumont tried his new monoplane (which he has christened "Demoiselle") at St. Cyr. A number of short flights were made, no particular difficulty being experienced in getting up in the air. One of these flights terminated rather suddenly, with the result that one of the wheels buckled.

On account of the small size of his monoplane, Santos Dumont was able to carry it from Paris to St. Cyr on the rear of an automobile, as is shown in one of our illustrations. This is the first time, so far as we know, that an automobile has been used for transporting an assembled aeroplane from the city to a suitable place in the country, where the aviator can conduct his experiments.

THE FOURTH AEROPLANE OF THE AERIAL EXPERIMENT ASSOCIATION.

The photographs reproduced herewith show the latest aeroplane—"The Silver Dart"—of the Aerial Experiment Association, and also the third, or "June Bug," aeroplane, which has been remodeled and mounted upon pontoons for experiments upon the water.

The fourth aeroplane which the association has constructed has the same general lines as the "June Bug," which preceded it. Some modifications, however, have been made in the curve of the surfaces and in their size and spacing, while the new machine has no tail whatever, since the later experiments with the "June Bug" showed this to be unnecessary.

While the ribs of the former aeroplanes had a reverse curve at the rear (which form of curve the experiments of W. H. Turnbull demonstrated to be the most efficient), it was thought that the upward pressure of the air upon the flexible rear edges of the planes made this reverse curve too pronounced, and tended to check the forward motion of the aeroplane. Consequently, the ribs of the new machine have only a single curvature, and it is believed that the air pressure upon the rear edges of the planes will automatically produce the slight upward curvature at this point. The width of the planes from front to back at the center has been reduced from 6½ to 6 feet, and the spacing apart of the planes also has been reduced to this figure. The width of the planes at their outer

ends is 4 feet, and they are spaced 4 feet apart. These changes have given the new machine somewhat finer lines than its predecessor. As the movable wing tips of the "June Bug" were not sufficiently powerful, larger tips have been fitted to the "Silver Dart." The total area of these is 40 square feet. The spread of the planes has been increased to 49 feet. This, added to the greater area of the tips, will doubtless give better transverse control. The total area of the supporting surfaces is 420 square feet.

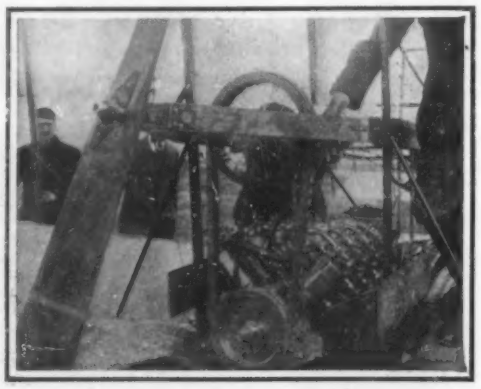
The central part of the machine, which contains the power plant, steering wheel, and control mechanism, is very substantially built, and is complete in itself. The four planes are attached to this central section (which has sockets to receive their frames), and are secured in place by guy wires tightened by turnbuckles. The rubber-covered silk forming the surfaces is made in sections, which are laced over the ribs to the frames of the wings. The ribs slide in pockets in the silk. They pass beneath the rear part of the wing frames, and abut against the back edges of the front members of these frames. Small tin caps strung on a wire that runs through a seam in the rear edge of the silk, slip over the rear ends of the ribs. This wire, which forms the rear edge of each plane, is secured to the central section and to the outer ends of the wing frame, and is drawn taut by means of a turnbuckle. The wing tips and the rudder surfaces are covered by two thicknesses of silk, sewed together, and forming a pocket that is slipped over the frame of the wing tip or rudder. This gives a smooth surface on either side of the wing tip or rudder. A rib of steel tubing is used in the main planes, at the points where uprights connect them, as this has been found to greatly strengthen the planes. The uprights fit into suitable sockets on the frames of the upper and lower planes, and are held firmly in place by the guy wires, all of which are provided with turnbuckles.

The vertical rudder is carried on hinged bamboo struts about 11 feet back of the rear edge of the central section of the planes. The dimensions of this rudder are 2 by 4 feet. A wire cable runs to the tiller of the front running wheel (which steers the machine when it is on the ground). The tiller is in turn connected to the hand steering wheel of the machine, which thus operates the vertical rudder.

The horizontal rudder is of the double-surface type, and is placed 15 feet in front of the planes. It has a direct connection to the steering post, so that by pushing or pulling on the steering wheel, the rudder is directed downward or upward. The dimensions of the planes of this rudder are 12 feet long by 28 inches wide, and they are spaced 30 inches apart. The rudder is pivoted at a distance of 5 inches back of its forward edge, and is supported upon a bamboo cantilever truss.

The center section of the aeroplane is mounted upon a three-wheeled running gear consisting chiefly of two longitudinal wood girders similar to those used on the "June Bug." There are some improvements in the construction and the material used is heavier, however. The same may be said of the fish-shaped uprights and plane frames, which are all of heavier material, and hence are capable of withstanding greater shocks.

The new aeroplane is intended to carry two persons, one sitting directly behind the other. An adjustable seat has been arranged, so that it can be slid forward or backward to the proper point when only one man is carried. The passenger is expected to sit directly over the theoretical center of pressure when the machine is under way. As a result of this, if no passenger is carried, the balance of the machine would not be affected materially. The movable wing tips are controlled by a device which does not interfere with the passengers, and which may be adjusted with the seat. The tips are controlled by the swaying of the body of the aviator from one side to the other. The rod connecting the steering column to the front rudder can be lengthened or shortened by means of a telescopic tube, in case the aviator wishes to move his seat to a point farther forward or backward. The engine of the "Silver Dart" is a 3¾ by 4-inch 8-cylinder, water-cooled, Curtiss motor, capable of developing 50 horse-power at 1,600 R. P. M. Including the radiator, water, oil, etc., the weight of the complete power plant is 250 pounds, but the engine alone can be stripped to 165. The cylinders are fitted with copper water jackets and auxiliary exhaust ports. Circular concentric valves are located in the cylinder heads, the inlet valves being automatic. The crankshaft is of specially treated vanadium steel. It is bored out hollow and is 1⅜ inches in diameter. The connecting rods are steel forgings, the cylinders and pistons being cast iron. The crank case is made of special aluminium alloy. The main bearings of the crankshaft are continuously flooded with a bath of oil by means of an oil pump of the gear type. Individual



The power plant of the "Silver Dart."
The 8-cylinder Curtiss drives an 8-foot wooden propeller by means of a V-shaped belt. The propeller makes 1,000 revolutions per minute to 1,600 of the motor.

aluminium carbureters are employed with all eight cylinders. The engine is placed upon a bed located on top of the rear part of the lower plane, and it is braced from the chassis below. The placing of the engine at this point will put less strain on the machine when landing, and will also bring the center of gravity somewhat lower than was the case with the "June Bug." The propeller, which is 8 feet in diameter, and of about the same pitch, is mounted upon a short shaft above the engine and halfway between the two planes. It is driven by twin V-shaped belts similar to those used upon motorcycles, and there is a speed reduction from the engine to the propeller of 1½ to 1. The propeller is made of laminated wood and weighs, including the two clamps on each side of the hub, 8¼ pounds. The line of thrust is about on a level with the line of resistance of the machine, but is inclined above the horizontal about 3¼ degrees.

The angle of attack of the surfaces of the aeroplane at their outer ends is 9¼ degrees. This angle is somewhat excessive, but it makes it easier for the aeroplane to rise, and probably when the machine is in flight the angle will be reduced to 5 or 6 degrees. It is on this supposition that the angle of the propeller shaft has been slightly raised above the horizontal. The proper angle for the shaft can only be found by experiment.

All the framework of the aeroplane, as well as the brace wires, etc., has been carefully measured and the head resistance of the machine computed by the methods and coefficients employed by Mr. Octave Chanute. The equivalent head resistance of the machine in square feet of flat surface has been figured out to be 2,188.47 square inches, or 15.19 square feet.

The weight of the machine complete with a 150-pound man, and with the tanks filled with oil, gasoline, and water, is about 860 pounds, so that the loading of the surfaces is but 2.04 pounds to the square foot. This is a low figure, and should make it possible for the machine to carry a considerable amount of additional weight, and to fly at high speed.

The aeroplane "Loon," in a recent test upon Lake Keuka, at Hammondsport, N. Y., covered two miles (one mile against and one mile with a wind of 5 or 6 miles an hour) in 2 minutes and 26 seconds, or at an average speed of 27.06 miles an hour. This speed was not sufficient to enable the aeroplane to rise in the air and lift the floats upon which it was mounted. It is intended to make further experiments with a type of hydroplane hull.

The Current Supplement.

The opening article of the current Supplement, No. 1719, describes a novel type of traction road train which has met with success in Germany. The British metallurgist Cowper-Coles has devised a process of producing electrolytic iron in the form of finished sheets and tubes. This process is thoroughly described. Selenium cells and their varied uses are ably discussed by R. A. L. Snyder. Objections have been raised to the use of water resistances for the testing of alternating-current machinery. Karl Wallin has carried out tests at the Technical School of Stockholm in order to investigate the problem, using low voltages. The substance of his experiments appears in the current Supplement. Prof. S. J. Meltzer discusses in the Supplement whether or not, as in the human-made machines, the structures and functions of the animal mechanism are provided with factors of safety. Mr. Edgar A. Custer's paper on Casting Pipes in Permanent Molds is concluded. Some time ago, the American Society for the Prevention of Cruelty to Animals offered a prize of $500 for a device which would slaughter animals for food purposes more humanely and practically than is at present the case. The report of the prize committee on the subject is published. The cash value of the prizes which have been offered up to date to stimulate aeronautic inventors amount to nearly $350,000. In the current Supplement will be found a complete list of them.

Detection of Soap Bark.

Soap bark (*Quillaja*), soap wort (*Saponaria*), and other vegetable substances containing the glucoside saponin are often added to effervescent beverages in order to give them body and to produce foam. The presence of saponin is most surely detected by Brunner's process. To 100 parts of the liquid, previously neutralized with magnesium carbonate, 20 parts of ammonium sulphate are added, and the mixture is shaken thoroughly with 9 parts of phenol. The phenol, after it has separated, is next shaken with 50 parts of water, 100 parts of ether and 4 parts of alcohol. The supernatant aqueous portion is then poured off and evaporated to dryness, and the dry residue is tested with acetone for saponin. If the liquid contains dextrine this must be removed before the process is applied.

The first annual exhibition of the Junior Aero Club of the United States will be held December 18 to 26 at Madison Square Garden, New York city, space for the purpose having been set aside by the management of the Holiday Bazaar. The Juniors will be pleased to receive for exhibition anything relating to aerial transportation from anyone under twenty-one years of age, whether members of the club or not. Contests for prizes will not be held until later in the winter, and non-members will not be eligible for such contests. All those who do not send models are cordially invited to send drawings on paper 10 x 15 inches in size, with their name, age, and residence written in the lower corner. Any boy in the United States may enter a model or drawing of a novel kite, miniature glider, aeroplane, spherical or dirigible balloon, or motor suitable for model work, etc., designed or made by himself. No models may be more than six feet in length over all, and preferably not more than four or five feet. Any kind of motive power may be used. Drawings are to be sent to Miss E. L. Todd, 131 West 23d Street, New York, at any time before December 16. Applicants should write for information with regard to the exhibiting of models.

The remodeled "June Bug" (now called the "Loon") mounted on floats.
A water-cooled motor is now used, the radiator for which can be seen projecting through the upper surface.

Front view of the Aerial Experiment Association's aeroplane "Silver Dart."
Note the two-surface horizontal rudder and the movable wing tips on the ends of the planes. There is a single vertical rudder in the center at the rear.

THE FOURTH AEROPLANE OF THE AERIAL EXPERIMENT ASSOCIATION.

MECHANISM OF THE OVIPOSITOR DRILL.

BY S. FRANK AARON.

Hamilton Gibson called the wood-piercing ovipositor of the great ichneumon fly (*Thalessa*) "the most wonderful drill in the world." Probably, considering the length of the drill, the mechanism of the cutting points, and the fact that Nature has developed this tool out of animal matter, the artist naturalist's appellation is merited. Knowing what this tiny drill is able to perform, and comparing these performances with the power behind the drill, naturally adds to our interest in determining the character of the instrument. We may also compare the ovipositors of other closely-related species, the hornflies of the genera *Urocerus* and *Tremex*. Of these, the well-known pigeon tremex is the most available for study.

The writer has observed the *Tremex* laying her eggs in a dead apple tree, near the butt of the tree and through the thin bark into the hard, solid wood. In a period of less than two minutes the ovipositor cut its way over half an inch into the wood. It was at once apparent, in watching the progress of the drill and the insect controlling it, that it was not a thrusting force that continually worked the drill. The insect stood widely astride of the spot, and the ovipositor, drawn out of its long sheath, was almost at right angles to the abdomen. The thorax of the *Tremex* moved very slightly from side to side, giving to the abdomen a somewhat twisting motion, and there was a slight downward motion also, evidently in the endeavor to keep the point at work.

Some idea as to the manner in which the boring is done may be gained from an examination of the boring itself in longitudinal section, a piece of the wood having been carefully cut from the tree where the insect's ovipositor is withdrawn. The hole in the wood is exceedingly straight and smooth, with indications of lengthwise cutting marks. Upon capturing the specimen also it will be found that the ovipositor is very much smaller than the boring, possibly not more than one-half its diameter.

It is very obvious that no matter how keen and hard the ovipositor might be, if it were merely thrust into the wood, no material of the kind could be trusted not to bend or break, and even were this not the case, the insect, though stout and active, could not exert a thousandth part of the force needed. It is apparent then that the drill must make its way into the wood by some special mechanism, fitted for cutting the way clearly, and upon examination we find that this is the case. In a construction of this character Nature seems to have rejected the tube, both in the insect's drilling ovipositor and the piercing and sucking proboscis of the flies, so that not only is the protecting sheath in two pieces for its full length, but the harder drill itself is made up of four parts. This allows of greater flexibility and naturally, therefore, in the work it has to do, of greater strength.

The ovipositor of a *Tremex* consists of two outer sheaths, somewhat similar in character to the protecting sheath in which it is carried when not in use, and a central shaft in two parts. The whole is as slender as a horsehair. At the end of this lance the outer sheaths are broadened or swelled, with file-like ridges, and then brought to a point, and within this enlarged end moves the central lance, also toothed, file-like, and bluntly pointed somewhat like the tooth of a saw. When this instrument is at work the sheaths are sufficiently divided at the end, to permit the teeth of the lance to protrude. This latter instrument is worked back and forth, and the small teeth cut away the wood at the bottom of the hole, much as a jig-saw does through the thickness of a board, the ovipositor having the much more difficult task, as it must get rid of its rapidly accumulating sawdust. This dust works its way to the surface, impelled by the withdrawing motion of the rasp-like teeth. Upon capturing the specimen observed drilling in the tree and examining the ovipositor with a magnifying glass, the writer observed the central lance protruding from the side of the swelled ends and moving up and down, presumably much as it does when boring, though influenced spasmodically by the struggles of the insect to free itself. It is not certain that it moved in just the same way. As the insect does not turn around, so as to bring the cutting edge of the lance upon all sides of the hole, it becomes somewhat difficult to imagine in just what manner the hole is made so regular and even. It is necessary that the hole be larger than the drill ovipositor, in order to permit the swelling of the latter when the egg is passed through it into the bottom of the boring.

The Tremex drill contains two gouges and two saws.

a, Side view; *b*, posterior; *c*, anterior view; *d* shows saws extended beyond gouges when at work, and *e* saws withdrawn to expel sawdust from the boring.

The Thalessa drill.

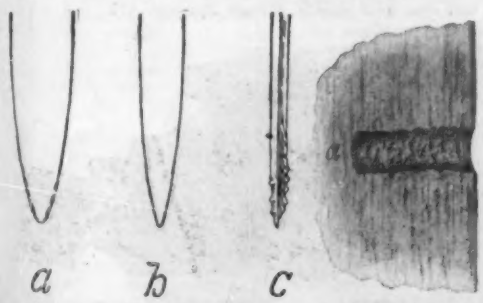
y, The gouge; *x* and *x x*, the two saws; *a*, anterior view; *b*, lateral view; *c*, saws extended below gouge as in drilling. *d* shows section at *s* with dots showing relative position of points. *e* shows position when egg is passing through ovipositor.

A still more wonderful drill is that of the great ichneumon fly, *Thalessa*, two species of which are common. They are known as *Thalessa lunator* and *Thalessa atrata*, the latter shining black and less common. The ovipositor is very much more slender than that of a *Tremex*, and that of the black species is over four times as long. It is, therefore, all the more remarkable to see this insect boring a hole for nearly the full length of its hair-like drill in solid oak, locust, pear, apple, or other equally tough-wooded trees. The drill ovipositor is carried in a long scabbard of two pieces and opening its full length. The drill proper is of three parts, one piece convex on its outer surface, concave within, finely pointed and having near the end three and sometimes four external, blunt, wart-like teeth. The other two pieces are alike, though opposed, flattened and more slender, the ends of each with ten or eleven rasp-like teeth and more prominent nearest the apex. These move freely within the more concave semi-sheath, the points of all working together and alternately effect the cutting, while as in the *Tremex* the rasp-like, rigid teeth, in the withdrawing motion, work out the sawdust, a steady stream of which flows from the boring when the drill is at work.

But there is a problem in what manner these drills effect the initial cutting at the extreme bottom of the boring. It is not difficult to understand from an examination of the file-like teeth of the drills how the boring is made larger than the drill. Gibson does not enter into a description of the mechanism of the instrument, but briefly refers to the boring's being accomplished by the alternate gouging of the chiseled tips of the three long pieces. This is not satisfying. From an examination of the instrument, it is more like the cutting of saw teeth or of file teeth than of chisels. Nor does it at all resemble an auger in its character. Beyond question, it is the withdrawing motion of the cutting pieces that loosens the particles of wood on the sides of the boring, the rigid teeth being all of the hook character, as in a file or saw, with the edges turned upward or backward. In some way the motion of the cutting points of the drill loosens the particles of wood at the bottom of the boring, which upon examination proves to be only slightly convex where the points are at work, showing here also that the drill moves from side to side and around in its work.

A *Tremex* bores a hole almost the extreme length of its ovipositor, lays an egg therein, withdraws, and flies away. This egg hatches a tiny grub that at once begins its work as a wood borer, hibernating within its burrow, and reaching its full development the following season. As is well known, a *Thalessa*, ascertaining the position of the *Tremex* larval boring by a subtle sense that we cannot comprehend, proceeds to drill through the hard wood, and unerringly reaches the retreat of the *Tremex* larva and lays an egg therein. This hatches a larva that searches out the *Tremex*, fastens upon it, sucks its juices, and eventually kills it, the *Thalessa* thereupon passing through its transformation in the boring of the *Tremex* and emerging the following summer, at about the time that a *Tremex*, if unmolested, would have done. When a *Thalessa* drills its boring, the *Tremex* larva has perhaps reached a considerable depth in the wood, hence the necessity for the very long drill of a *Thalessa* as compared to the shorter one of a *Tremex*. If a *Tremex* possessed a drill like the *Thalessa* and its larva could begin its boring at such a depth, then the drill of the *Thalessa* would need to be, perhaps, doubled in length. The ovipositor drill of a *Thalessa* is three or four inches long, and that of a *Tremex* less than an inch.

Considering the delicacy of the *Thalessa* drill, the comparatively slight power behind it, and the hardness of the wood into which it is often thrust, nothing in the mechanism of Nature is more truly wonderful. Possibly it is only surpassed by the ability of the insect to ascertain the exact position of its victim at such a depth in the solid wood.



Comparative size of drill of Thalessa.

a, Pin-point; *b*, point of fine needle; *c*, lateral view of point of ovipositor.

Longitudinal section of boring of Tremex.

Depth, ¼ inch; diameter ⅛ inch.

Luminous Projectiles.

It is proposed to substitute for searchlights on warships guns firing projectiles which will emit intense light, either during their flight through the air or on striking the water. The short duration of the flight, however, appears to make the first method impracticable. For the production of light on striking the water calcium carbide is the most suitable substance, as, on contact with water, it generates acetylene gas which, when ignited, produces a very intense light. The latest form of acetylene or carbide bomb comprises two cylindrical wooden shells, which telescope together. The inner shell is filled with calcium carbide, calcium phosphide, and gunpowder, not mixed together. It has an iron head and, at its opposite end, an orifice for the escape of gas.

The two wooden cylinders separate immediately on leaving the muzzle of the gun and the inner cylinder continues its flight alone. On striking the water the projectile, after the first plunge, rises to the surface. Water enters the shell and evolves acetylene from the carbide, and hydrogen phosphide or phosphureted hydrogen from the calcium phosphide. The hydrogen phosphide ignites spontaneously on contact with the air and sets fire to the acetylene. The flame is not extinguished, but rather brightened, by contact with water, so that an intense light is produced even in a high sea. An intensity of 2,000 candles and a life of three hours are claimed for these acetylene bombs, and they can be projected to distances of two miles or more. Yet they form very incomplete substitutes for searchlights. They are of little use in the search for hostile torpedo boats because they are useful only when the position of the object to be illuminated is already approximately known. Even in such a case a torpedo boat could easily escape from the area illuminated by the bomb before it could be hit by the enemy's guns.—Prometheus.

At the recent *soirée* of the British Royal Society, Mr. J. Franklin Adams, F.R.A.S., exhibited the ingenious machine he has evolved in order to complete his extensive star-counting task and preparation of the star chart of the heavens. After securing photographs of every section of the northern heavens at various points, this astronomer in 1895 went to Cape Town and secured negatives of the southern heavens. In all 260 successful negatives were obtained, upon which are recorded something like 23,000,000 stars. The task of counting this huge aggregation has almost been completed, but it has occupied nearly seventeen years. By means of his special machine precession lines are drawn upon his plates, which are 15 inches square, the latter lines 0.01 millimeter apart giving star places at the 1855, 1875, 1900, and 1925 epochs both in right ascension and declination. This machine works with such minute accuracy that regions adjacent to the selected areas can be subsequently added without overlapping or omission.

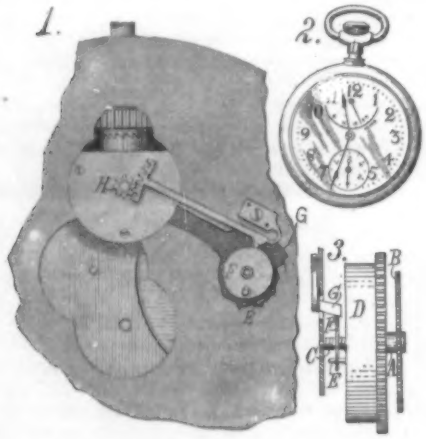
The pigeon horntail (Tremex columba) boring in wood.

a. Ovipositor drill forced in vertically; length, ¾ inch. *b*. Sheath attached to body horizontally. Sheath not used to strengthen the drill as in Thalessa.

Patent Department

WINDING INDICATOR FOR WATCHES.

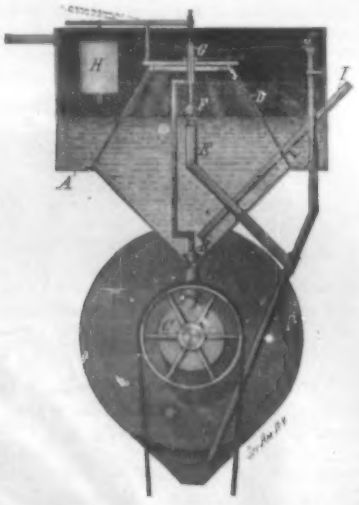
In watches of the better class, and especially in chronometers, it is quite important to know just to what extent the spring has been wound; for in winding the spring to the limit one is apt to strain the delicate mechanism. Such an indicator has recently been devised which operates in a very simple manner. As shown in Fig. 2 of the accompanying engraving, a small indicating hand is provided on the face of the watch which, as the watch is wound, will move in one direction over a graduated dial and when the watch is running will move in the opposite direction. In Fig. 3 the winding arbor is indicated at *A*, to which is attached the winding gear *B*. The arbor *A* is provided with a reduced extension *C*. On this extension a disk *F* is threaded, and the latter is arranged to revolve with the spring barrel *D*, by reason of the fact that a pin *E* carried by the barrel passes through an aperture in the disk. The watch is of that type in which the opposite ends of the spring are secured to the barrel and arbor respectively, and both the barrel and arbor rotate in the same direction, the latter during the winding of the watch, and the former when the watch is running. With the arbor *A* is revolved the disk *F*, which being prevented from rotating by its connection with the drum *D* is fed inward in contact with a cam surface on the spring lever *G*. The latter is provided with a toothed sector which engages the pinion *H* and moves the indicator hand attached thereto over the winding dial. When the watch is running, the disk *E* rotates with the barrel, and is thereby threaded outward on the shaft *C*, permitting the spring lever to return to its normal position, and thereby moving the indicator toward the unwound position. The inventor of this mechanism is Mr. Samuel Kahan, 1061 Park Avenue, New York, N. Y.



WINDING INDICATOR FOR WATCHES.

GRAIN-WASHING MACHINE.

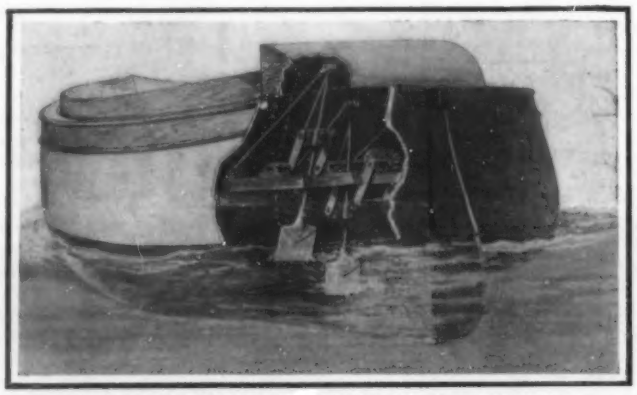
Pictured in the accompanying engraving is a grain-washing machine which is arranged in such a manner that when the machine becomes choked the sound grain is prevented from passing out through the overflow employed for carrying off extraneous matter. The engraving shows the machine in section, the tank being indicated at *A*. This tank is fed with water from a supply pipe at its upper end and discharges past a grain valve *B* into the beater *C*, from which the grain passes to the straining device in the usual manner. A chamber *D* is provided within the tank *A*, and the stem of the valve *B* passes up through this chamber, being formed with a sleeve *G* at its upper end to receive the rod of a valve *F*. The latter serves to close the upper end of the discharge pipe *E*. The valve *F* is suspended from a lever to the opposite end of which a float *H* is hung. This float may be adjusted along the lever, in order to regulate the action of the valve. The grain delivery chute is indicated at *I*, while a secondary overflow pipe is shown at *J*. In operation the water washes the sound grain through the valve *B*, but extraneous matter floats to the top of the tank and is carried out through the overflow pipe *E*. In case the valve *B* should become choked, the water rising in the tank *A* will lift the float *H*, permitting the valve *F* to close, so as to prevent the sound grain from passing off therethrough. In case the water should rise to a dangerous height it would be carried out through the overflow pipe *J*. The inventors of this grain-washing machine are Messrs. W. F. Mullaney, C. B. Neuman, and M. Nicholson, of Marshall, Minn.



GRAIN-WASHING MACHINE.

NOVEL BOAT-PROPELLING DEVICE.

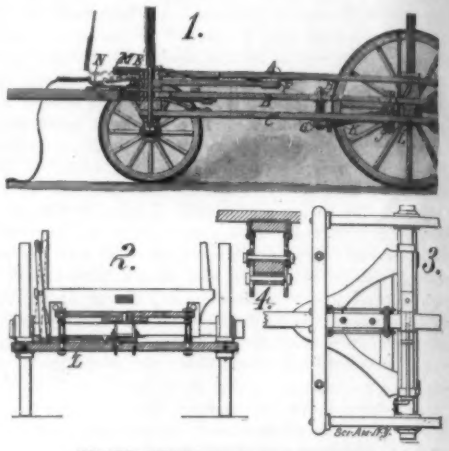
An oar-like boat-propelling mechanism has recently been devised which is adapted to permit of propelling a vessel at high speed on shallow waters. The mechanism requires but little power and does away with the long shaft connection between the motor and the propeller. The propelling mechanism is concealed in a well at the stern, this well being open at the bottom, as indicated in the engraving, which is partly broken away to show the mechanism. This well is divided into two compartments. In each compartment a pair of paddles are mounted to operate. The paddles are suspended from pairs of levers at their upper end, the lower ends of the levers being pivoted to a framework in the compartment. On each paddle stem a sleeve is mounted which is pivoted between the arms of a crankshaft. The crankshaft is propelled by any suitable engine through bevel gears, and as the cranks revolve each paddle is moved through the water, and by reason of the lever suspension each paddle is lifted out of the water on the return stroke. The return stroke occupies but one-third of the rotation of the crank, so that there are always at least two paddles in active engagement with the water, and at times during each rotation all four of the paddles are in the water together, two beginning and two ending the propelling stroke. Each paddle stem is provided with a number of bolt holes which permit of adjusting its position with respect to the supporting levers, thus regulating the depth to which the paddles will reach in the water. The inventor of this boat-propelling device is Mr. Whiting Arnold, of Murray Hill Hotel, New York.



A PROPELLING MECHANISM FOR SHALLOW-DRAFT BOATS.

BRAKE MECHANISM FOR WAGONS.

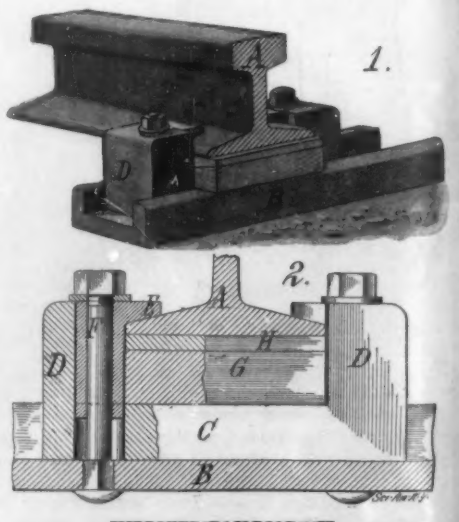
The mechanism which we illustrate in the accompanying engraving provides a very effective brake for wagons which will be operated by any back pressure of the front axle that is greater than that on the rear axle. The wagon is provided with a main reach *A*, and a second reach *B*, both of which are secured to the rear bolster, but have a limited sliding movement in the forward bolster. In addition to these two members there is a third reach *C*, rigidly secured to the forward bolster *E*, but free to slide in the rear bolster *D*. The main reach *A* is formed with an auxiliary part *F* rigidly secured to the bolster *E*, but having sliding engagement with the main reach *A*. This construction serves to strengthen the reach and hold it in alinement while permitting it to move with respect to the bolster *E*. Secured to the reach *B* is a cross-bar *H* from which is suspended the brake beam *G*, the latter being provided with the usual brake shoes which bear against the peripheries of the rear wheels. Connected to the brake reach *C* are a pair of pivoted arms *J* which are connected by links *K* to the brake bar *G*. In operation, when going down hill, the rear wheels will tend to ride forward with respect to the front wheels, carrying the reaches *A* and *B* with them, and also the cross-bar *H*. However, as the brake bar *G* is held back by its link connection with the arms supported by the brake reach *C*, the result will be to force the brake shoes against the wheels. When it is desired to disconnect the brake mechanism, a pin *L* is passed through the brake reach *C* and its support on the rear bolster. If while driving the wagon it is desired to stop the automatic action of the brake, this can be done from the driver's seat by lifting the notched bar *N* into engagement with the U-shaped bar *M*. The bar *M* being connected with the reach *A* and the bar *N* with the bolster *E* the result will be to lock these two parts together and prevent the forward movement of the rear wheels with respect to the forward wheels. Mr. Eben G. Doland, of Starksboro, Vt., has recently secured a patent on this brake mechanism for wagons.



BRAKE MECHANISM FOR WAGONS.

IMPROVED RAILROAD TIE.

The accompanying engraving illustrates a railroad tie which may be constructed of metal or concrete, and to which is bolted a rail chair, with lugs fitted in the chair to engage the base of the rail and hold it in place. Between the rail and the chair wedge-shaped blocks of wood are provided which not only serve as cushions for the rail, but also may be used to force the rail into alinement. In the engraving the rail is indicated at *A* and the tie at *B*. The chair *C* is placed under the rail, and is provided with vertical portions at each side. A vertical orifice extends through each side portion and into each orifice a lug *E* is fitted. The latter is formed with a sleeve which engages the orifice providing a long bearing. The lugs are held in place by means of bolts *F* which pass through them and the tie *B*. The wooden wedges referred to above are indicated at *G* and *H*. Should it be found that the rail must be raised or lowered, the bolts are loosened and the wedge-shaped members *E* and *H* are forced together or apart until the proper adjustment is attained, after which the nuts on the bolts are screwed home and the device is ready for service. The inventors of this improved railroad tie are Messrs. W. Hubbell and A. J. Annis, Siloam Springs, Ark.



IMPROVED RAILROAD TIE

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

HOOK-EYE.—A. C. CARL, Joplin, Mo. As ordinarily attached and located, hooks and eyes lie flat upon inner and outer sides of a garment and close to opposite edges of the same, and in engaging the hooks with the eyes, their points come in contact with the portion of the fabric directly underneath the eyes and wear and injure the goods. To prevent this result the eyes are provided with a guard interposed between them and the fabric, so that contact of the hooks with the latter is prevented.

BUILT-UP MATERIAL FOR BELTS AND THE LIKE.—JOSEPHINE MÜLLER, New York, N. Y. In this material the major portion of the warp consists of ribbons of oil-cloth, patent-leather, felt, etc., the glazed and finished faces of which are their outer faces and in which the weft consists of cord or braid, whereby to provide a fabric which when single ribbons are used is especially adapted for use as the body portion for bags and like articles, and wherein when the ribbons are used double or are placed back to back, a fabric is provided which may be equally finished on both faces, being especially adapted as material for waist belts.

HOSE-SUPPORTER.—H. ALLEN, New York, N. Y. One purpose in this invention is to provide a supporter or garter that is exceedingly simple, comprising practically but two parts, and wherein the supporting members, or those adapted for attachment to the sock, will draw equally upon the limb back and front.

HOLDER.—C. C. WILLIAMS, Westfield, Pa. The purpose of the invention is to provide a holder, arranged for convenient attachment to a support for easy manipulation, to engage and securely hold the article in place and for ready adjustment, especially when used as a cuff holder, to adjust the cuff relative to the coat sleeve.

COMBINED GARMENT.—M. TARTIKOFF, New York, N. Y. The invention consists of a supplementary waistband, and a shield, the shield and waistband being provided with buttons on opposite portions for detachably connecting them together and to a pair of pants or other similarly worn garments, with elastic members connected to the shanks of the buttons, holding them in place and affording a yielding connection between the pants and the shield.

SAFETY-CLASP FOR PURSES AND THE LIKE.—W. MCILROY, Empire, Panama. The object here is to provide a compact, easily operated device for detachably fastening a purse or a like receptacle upon the dress, skirt, or waist in such a manner that the purse cannot be easily stolen; and also afford a neat ornamental auxiliary pocket for convenient use.

SUSPENDER ATTACHMENT.—J. HAUSER, Spokane, Wash. The attachment affords means for reliably securing together the ends of the looped portions of suspender bands in a manner which will permit the release of the parts when a changed adjustment is desired, whereby the suspended bands are lengthened or shortened as occasion may require.

Electrical Devices.

INSULATING-BUSHING.—L. STEINBERGER, New York, N. Y. In this patent the invention has reference to insulating bushing such as may be employed in connection with high potential conductors, and used at points where such conductors enter or leave a building or pass through a wall, panel, or other barrier of any kind.

DISK STRAIN-INSULATOR.—L. STEINBERGER, New York, N. Y. This invention relates to strain insulators, and particularly those of the disk type, Mr. Steinberger's more especial object being to improve the general construction of such insulators and to render them, as near as practicable, proof against the evil effects of moisture. It relates further to increasing the dielectric properties of the insulators and giving them a high degree of mechanical strength.

FLEXIBLE SUSPENSION FOR CONDUCTORS.—L. STEINBERGER, New York, N. Y. This invention relates to means for suspending conductors, and more particularly to a flexible suspension for conductors such as are used for transmitting currents of unusually high potential. One object among many is to promote flexibility between the conductor and the cross arm or other stationary member, whereby the latter and its connections are supported.

TELEGRAPH-REPEATER.—L. B. CECIL, Santa Barbara, Cal. The main line in operation, makes and breaks in the circuit are repeated on the branch line through the contact of the contact point on an armature with the lower end of the trunnions. When the branch line is working, the makes and breaks in the circuit are repeated on the main line by means of the contact point and the lower end of a lever on a relay, and in either case the arm on the bracket of the relay which is working keeps the armature of the relay which is not working from operation.

RELAY FOR TELEGRAPHS.—J. SCOTLAND, Hearts Content, Newfoundland. The invention relates to the art of telegraphy and has for its object to provide a relay and more sensitive than those heretofore known. Another object is to so construct the relay that there will be a greater and a more rapid demagnification when the circuit on the main line is broken.

Of Interest to Farmers.

CHICKEN-PERCH.—W. H. COLE, Broken Bow, Neb. The object of the inventor is to provide details of construction for a perch, which adapt it to contain and automatically discharge a graduated quantity of liquid and insecticide, or germicide, from a reservoir in the pole upon the exterior surface, for extermination of lice or mites that infest fowls or growing chickens, and also for the destruction of disease germs.

TRAP-NEST FOR HENS.—M. J. WHITTY, Croton-on-Hudson, N. Y. The object here is to provide a nest with means for holding the door for the entrance sufficiently open to permit a laying hen to enter, and which will be released by the entering of the hen, permitting the door to spring closed, thus trapping the fowl until such time as an attendant may take the number of the fowl for recording the number of eggs laid during the season.

GATE.—E. J. A. RICE, Harvard, Neb. The more particular improvements relate to means whereby the gate may be readily operated by a person intending to pass through it, the improvements further tending to render the gate, as far as possible, easy in its action and simple in its construction.

GRAIN-SCOURER.—T. GROSE, Port Adelaide, South Australia, Australia. This machine for use in scouring grain has several advantages over scourers hitherto in use, in that it is simple and economical in manufacture, is far more durable, is driven much more slowly, requiring less motive power, and is most effective in operation.

Of General Interest.

THREAD-SPOOL.—E. A. ZOBEL, Holmesville, Neb. The invention pertains to an improvement in thread-spools, and in carrying it out, what is usually a waste product is utilized, namely corn-cobs, which are particularly useful for the purpose in view of their cheapness and the facility with which they may be worked up into the finished product.

SANITARY PIPE-STEM.—J. J. GOTTSCHALK, Taunton, Mass., and B. W. PHELPS, Providence, R. I. One purpose of the invention is to provide a stem adaptable to any pipe and so constructed as to form within the stem a reservoir of saliva and the reception of foreign substances, preventing such factors collecting in the bowl of the pipe or its stem except in the reservoir.

SASH-HOLDER.—E. T. GASKILL, Newbern, N. C. By this invention it is sought to provide a sash that can be moved up and down with equal facility and will be retained in any position to which it may be adjusted. In operation the sash will be held from rattling and can be secured in any desired position up or down and will be dust proof from the outside in the use of the invention.

DISPLAY-BOX FOR FRUITS AND VEGETABLES.—F. E. CABANIS, Platteville, Wis. The invention is in the nature of a skeleton guard for boxes or other receptacles for fruits and vegetables and other articles. It is so constructed that it is extensible lengthwise and thus adapted for boxes of different lengths, and it is also adjustable outward, or at different points to the open side of the box.

HAND-BAG.—T. R. WEIDEMANN, Jersey City, N. J. The object in this case is to provide a hand bag arranged to provide a main compartment and a plurality of supplementary compartments for the storage of money, handkerchiefs, and other articles, to which convenient access can be had without opening or otherwise disturbing the main compartment.

GRAPPLE.—C. L. SIMMONS, Spokane, Wash. The invention relates to hoisting and its object is to provide a grapple more especially designed for hoisting concrete blocks and other articles, and arranged to securely grip the article to permit of carrying the same to the desired destination and to allow the operator to conveniently release the article.

HARMONICA.—A. W. ANDERSON, Seldovia, Alaska. The invention relates to teething rings for children and has for its object to provide a harmonica in the form of a teething ring so that when it is used a sound or music will distract the attention of the child, and quiet it when it bites on the ring, and in that way cuts its gums with its newly formed teeth.

WATER-ELEVATOR.—A. HAAS, New York, N. Y. The purpose of the invention is to improve upon a construction for water or liquid elevators, for which Letters Patent were formerly granted to Mr. Haas, so as to adapt the same to conditions under which it has been found that a double spiral screw can be successfully employed, the improvements relating particularly to the construction of the body of the device and the double spiral screw, and the details of the construction at the receiving and discharging portions of the device.

SPRAY-NOZZLE.—A. S. WASHBURN, Germantown, N. Y. The nozzle is adapted for use in spraying trees, shrubbery, plants, and the like, so constructed that even when the liquid includes a preponderance of Paris green, lime, sulfur, etc., there will be but a minimum tendency to clog, it being possible for the nozzle to be continuously used for a long time without cleaning, the tendency of the nozzle in operating being to free itself of all particles contained in such mixtures.

COVER.—F. G. LAUSTER, Sr., Ionia, Mich. The cover is simple and inexpensive to manufacture, and has means for removably mounting it adjacent to the side of the barrel or cask after it has been removed from the top, thus obviating the necessity of either holding the cover or placing it on the floor, while the material is being removed from the barrel.

SHEARS-HOLDER.—H. L. KOCHER, Cementon, Pa. Means are provided for conveniently holding a pair of shears or scissors pendent on one leg of a pair of overalls worn by paperhangers, so that the workman can readily grasp the shears for use while at work, and instantly replace them in the holder when the use of both hands is necessary for the proper execution of the work.

Hardware.

SPIKE-PULLER.—W. E. WEBB, H. RODDA, and J. H. VIOL, Butte, Mont. The invention is an improved labor saving device for pulling spikes from railroad ties, and the like, in a rapid and easy manner, without pulling off the heads of the spikes. It may be of any desired size, but for the purpose of pulling spikes it should be about five feet long and of stout and substantial construction, capable of bearing a considerable strain.

HINGE.—W. B. RODMAN, Charleston, S. C. The invention has for its object the provision of a hinge in which the two main leaves are connected by lazy tongs formed of two intermediate leaves, arranged in series with the main leaves, and also by two auxiliary leaves arranged in series with the main leaves, each auxiliary leaf being connected to the opposite intermediate leaf.

SAW-TABLE GAGE.—M. E. LOEHR, Claypool, Ind. The object of this invention is to provide a new gage, by means of which the adjustment may be accurately determined and which will normally remain locked in position, but which, by movement of the hand, may be released for readjustment.

CARRIER.—A. K. LEE, Chaparal, Ariz. Ter. The object here is to provide a carrier, more especially designed for use on cans, pails, and like receptacles, and arranged to permit placing the carrier conveniently in position on the receptacle or removing it therefrom, and to allow of folding the carrier into a comparatively small space for shipping, storing, or other purpose.

Heating and Lighting.

GAS-MIXER.—L. M. SIMMONS, Reynoldsville, Pa. More particularly, the invention relates to that type of mixer in which there is employed a tube adapted to be connected to a source of gas at one end and adapted to be connected to a burner at the opposite end, and having within the tube a helical baffle to bring out the thorough and complete commingling of the gas and air, and to produce a uniform mixture thereof, so that there will be perfect combustion of the gas.

WATER-HEATER.—P. SASSO and J. P. FARUGIA, Alexandria, Egypt. The invention relates to water heaters, and the object of the invention is to produce a heater having a large heating surface, to the end that the water will become quickly heated. It may be used with fuels of any kind.

ADJUSTABLE REGULATING-COCK.—W. N. BEST, New York, N. Y. In this instance the invention has reference to certain improvements in cocks adapted for use with gas burners for lighting or heating purposes, and relates more particularly to certain improvements whereby the flow of gas is rendered more uniform and the extent to which the cock may be opened, limited.

Household Utilities.

AWNING.—W. G. BUSCHEMEYER and G. R. CASPARI, Louisville, Ky. The object of the invention is to simplify and strengthen the connection between the awning frame and window casement, whereby it may be cheaply manufactured and assembled, and is unlikely to become deranged or broken. It refers to awnings more especially disclosed in Letters Patent granted to Mr. Buschemeyer, in which provision was made for the discharge of heated air at the top of the awning.

CLOTHES-DRIER.—L. DUNCAN, Butte, Mont. The inventor's aim is to provide a drier, embodying details that adapt it for convenient service, render it light, strong, durable, and easy to erect in or out of doors, and permit parts thereof to be closely folded into a compact package when not in use.

WASHBOARD.—SARAH F. O'CONNOR, New York, N. Y. The board has hooks at each end for engaging over the top edge of the tub and supporting the board therein in a slightly depressed position, the board being preferably made of slats corrugated longitudinally on their upper faces, these corrugations not only engaging the clothes and preventing them from slipping when the clothes are scrubbed with a rubbing device, but also serving as a rubbing surface.

PAN HOLDER AND STOVE LID LIFTER.—B. KESSLER, Harlem, Idaho. This device may be used either as a holder or handle for pans, or as a stove lid lifter. The handle is fitted with a shank which terminates in a toe adapted to fit the slot of a stove lid. This toe may also be fitted into a fork which may be passed under a pan while a catch on the handle serves to grip the rim of the pan.

VENTILATOR.—H. SHLAMOWITZ, New York, N. Y. One object of the invention is to provide a ventilator for use in connection with windows or other openings in buildings, which is so constructed that in a certain arrangement of the parts air can enter the room freely, but in an upward direction, that is, in a direction toward the ceiling, the air at the same time screened to prevent the entrance of dust, dirt, or the like.

Machines and Mechanical Devices.

DOOR-HANGER.—E. G. WORDEN, New York, N. Y. The object of the improvement is to provide a hanger which will facilitate the hanging of the door and enable the height of the door to be nicely adjusted. Further, the object is to construct and arrange the parts so as to relieve the mechanism of jars or shocks, when the door is swung open or closed.

AUTOMATIC SPEED-CHANGING MECHANISM.—K. V. HÖHNE, 20-21 Uhlandstrasse, Charlottenburg, Germany. The purpose here is to provide a method and apparatus by means of which the speed ratio of pulleys, shafts, and the like connected by gearing can be changed automatically in accordance with the greater or smaller speed of the driven pulley, shaft, or the like, in such a manner as to secure a uniform speed of rotation of the motor.

WATCHMAN'S TIME-REGISTER.—G. W. ELLIS, Germantown, Pa. With this recorder it will be impossible to register except at such times as a pin is in engagement with the switch arm, which occurs once every two hours, and is not of long duration, and it will be equally impossible to register unless such station has been visited. Since all the mechanism may be inclosed, no tampering with the record is possible, and a glance at the numbers appearing through the slit will show at once, whether the trips have been made, and if not, on what days trips are omitted.

AUTOMATIC DEPOSIT-BOX.—H. G. DORSEY, Granville, Ohio. The invention relates to improvements in deposit or collection boxes, and relates more particularly to locking mechanism for controlling the same. It is adapted for use in connection with boxes of any size or character, or employed for doors of rooms, bath houses, etc. The nature of the locking mechanism is not dependent upon the nature of the box or room in connection with which the mechanism is employed. The time control may not be employed in connection with the other mechanism.

AIR-COMPRESSOR.—H. E. BAILEY, Albany, N. Y. The intention in this case is to provide an air compressor which is simple and durable in construction, not liable to leak or to get out of order, and arranged to prevent the water from accidentally passing into the receptable filled with beer or other liquid.

CURRENT-MOTOR.—J. B. JEFFREY, Fairview, British Columbia, Canada. In the practical application of this invention Mr. Jeffrey provides a wheel adapted to be supported horizontally in the current of a stream, motion being imparted to the wheel by the action of vanes secured to the periphery of the wheel. The invention is entirely automatic in its action. No attention is required after the wheel is once lowered into the water.

POWER-HAMMER.—J. HAMILTON and L. PIERCE, New York, N. Y. One purpose of the inventors is to provide a stationary channeled piston rod and a hammer that is in the nature of a piston, sliding on the rod, together with a valve connected with a source of steam supply, or a supply of compressed air, and exhausts, which valve is controlled by mechanism operated by the movement of the hammer, whereby the valve is opened alternately to one or the other port or channel in the piston rod to cause the hammer to rise and fall.

SAWMILL-DOG.—A. V. WINEMAN, Greenville, Miss. In the operation of the device, the upper dog is moved into contact with the log after which the lug is engaged with a notch. On now swinging a lever the sliding bar is moved downward to force the upper dog into the log, and the lower dog is swung to force the latter also into the log.

LOGGING APPARATUS.—T. W. TILBY, Bellingham, Wash. The aim of the inventor is to provide an apparatus which will, in operation, give complete control of the logs which are being moved and which will obviate the necessity of using brakes for holding the log cable when the log is descending a grade.

TACK-DRIVER.—D. A. SAWYERS, Unionville, Iowa. The invention refers to mechanism for use in driving tacks, nails, and the like, the more particular object being to provide a driver with an improved form of magazine for holding the tacks, and further provided with means under control of a trigger and a lever actuated directly by the operator for discharging the tacks one at a time and driving them as discharged.

LUBRICATOR.—J. P. JOHNSON, Abercrombie, N. D. The object here is to provide a lubricator by means of which moving bearings can be continuously supplied with oil from a stationary reservoir, which is so constructed that it is impossible for dust or other foreign matter to become mixed with the oil being fed to the bearings, and by means of which the different bearings can be simultaneously sup-

plied with different quantities of oil in accordance with their requirements.

BARREL-PACKING MACHINE.—J. H. Voot and L. Stoack, Stamford, Conn. The invention is an improvement in packing machines for barrels and such like shipping cases which are filled with granulated or pulverized material and has for its purpose to provide for the uniform hammering or application of pressure to the material as the latter is placed in the case.

Prime Movers and Their Accessories.

MEANS FOR CONNECTING AND DISCONNECTING RECIPROCATING ENGINES.—S. S. Smith, Osage, Iowa. The object of the improvement is to easily and quickly disconnect any reciprocating engine, and especially those of a locomotive, and leave the same balanced after it has been disconnected as it was while working or under normal working conditions. In such engine construction counterbalances are used to equalize the weight of the pitman or connecting rod.

INTERNAL-COMBUSTION ROTARY ENGINE.—H. Lee, Bowral Street, Kensington, near Sydney, New South Wales, Australia. The purpose of the inventor is to provide an engine working on the rotary principle, which will utilize the power of the gases generated by the explosion more fully than heretofore. Its essential features consist of a rotary compresser, an intermediate rotary valve, and a nave or rotor carrying a sliding piston within a chamber of peculiar construction and varying contour.

Railways and Their Accessories.

CAR-FENDER.—C. Kleymeier, Covington, Ky. The purpose of this invention is to provide details of construction for a street car fender, which render the device compact and convenient for placing upon or removing from a car; the fender, when in position for service, being adapted to positively guard against accidents, and when in operation gently but positively removing laterally from the track a person or object, that is picked up by the fender, and without injury to the person or object.

RAILWAY CROSS-TIE.—F. N. Drane and H. A. Drane, Corsicana, Tex. The object of the invention is to provide a tie, provided with spaced concrete tie blocks, connected with each other by a metallic cross rod, extending centrally through the blocks and having means for adjusting the blocks toward or from each other, to bring rails held on the blocks to proper gage, and to allow of raising either block and maintaining both blocks and their rails in the same plane.

Pertaining to Recreation.

BOWLING-ALLEY. — C. B. Brenneman, Boston, Mass. The invention is an improvement in bowling alleys and the alley-way is of ordinary form and construction, comprising the floor, the side walls, and the return grooves, adjacent to the side walls, and upon each side of the floor. Instead of pins, balls are used, and that portion of the floor upon which the balls are placed is provided with depressions arranged in proper position with respect to each other.

Pertaining to Vehicles.

WHEEL FOR MOTOR VEHICLES.—J. V. Pratt, Guiting House, Allesley, Warwick, England. This invention relates to the wheels of road vehicles, and the object is to provide a reliable and readily detachable wheel. It consists in a wheel composed of a permanent wheel hub, a removable hub enveloping the permanent hub and carrying the spokes and felly clutched members between and formed integral with the hubs.

VEHICLE-WHEEL.—G. H. Groth, Cincinnati, Ohio. The invention relates to certain improvements in vehicle wheels, and more particularly to the steering wheels of motor vehicles. The object is to so construct the wheel that the ordinary steering knuckle may be employed, but at the same time, the pivot of the steering knuckle may be located in the plane of the wheel.

SELF-PROPELLED VEHICLE.—C. Richter, Tampa, Fla. The invention relates to self-propelled vehicles, and more particularly to that class usually characterized as automobiles. An object of the invention is to provide a self-propelled vehicle which is adapted to travel on land and water. Also to provide a vehicle adapted to travel on land and water and having means for propelling the vehicle on land and water.

LAND-ROLLER.—H. P. A. Andersen, Cushing, Neb. The invention provides a roller, wherein plain disks with a central peripheral grip alternating with toothed disks mounted upon a common axle, so that they revolve with the axle and revolve thereon, whereby opposing plain disks form ridges and pack the soil, preventing the finer particles from rolling away, while the interposed tooth disks penetrate the crowns of the ridges, cultivating the ground and leaving it in the best condition to absorb moisture, thus tending to prevent the earth from being washed away.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Full hints to correspondents were printed at the head of this column in the issue of November 14 or will be sent by mail on request.

(11012) H. J. P. says: 1. When a town is being changed by an electric company from a direct-current system to an alternating, it is not possible to run a motor of any kind of direct-current type with the alternating system, is it? A. Some forms of alternating current may be used upon a direct-current motor by bringing the motor to speed before the current is thrown on. The motor will then keep step with the current. It is far better to use a self-starting alternating-current motor. 2. Which is considered the most up-to-date system, the direct or the alternating current? A. The alternating current is displacing the direct current in a great many places. 3. Rewiring of the houses I presume would not be necessary? A. The house wiring is the same for both kinds of current.

(11013) J. M. K. says: 1. How should I make the connections for a miniature overhead trolley line, direct current? A. The positive pole of the current is usually connected to the trolley wire and the negative pole to the rails. 2. Are magnetism and electricity the same? A. Magnetism and electricity are not the same. Magnetic whirls are the result of an electric current, and surround the wire through which an electric current is flowing. 3. In your issue of October 17, 1908, page 257, is an article on ice making at home. Is Prof. Audiffren's machine on the market? And if so, where can it be gotten? A. The machine will probably be placed on the market in this country in a short time. Address will be supplied by mail. We do not give addresses in this column. 4. Cannot the current from a 6-volt, 4-ampere direct current be raised to 110 volts direct current through transformers or something? A. An electric current can be transformed from 6 volts to 110 volts, by means of a transformer, but the amperes will be cut down in the same ratio as the volts are raised. Starting with 4 amperes you will have about 0.2 ampere at the finish and not much work can be done. 5. Acetylene gas made from calcium carbide is not adapted for use in balloons.

(11014) R. S. says: Would you kindly inform me whether a dynamo is capable of creating more power than that required to run it? In other words, when a dynamo is creating a certain amount of power, is the power back of the dynamo greater or less than that created? A. The power used to drive a dynamo is always greater than the electrical power which the dynamo can furnish. There are no perpetual-motion machines in operation as such a one would be if it could furnish more power than is put into it to make it go. The dynamo is simply a transformer of energy and not a creator of energy. There is no machine which can create energy. All machines merely transform energy to some special use, always with a loss, the object being to get some other form of service, the loss being the price paid for the exchange. Steam in the engine cannot be used for light; electricity can be so used. Steam cannot be conveyed many miles to drive cars at a distance from the engine house. Electricity can be conveyed hundreds of miles, and there be used as power or light.

(11015) L. W. H. says: If you will allow me I will state the question: In a dynamo, electricity is generated by the armature shaft cutting the lines of force of a magnet. Is it a fact that clouds passing east or west generate more electricity than those passing north or south, considering the earth as a great magnet? Is this why our electrical storms come from the west? A. We do not know whether clouds moving from west to east generate more electricity than do those moving north or south. Storms all move from a westerly toward an easterly quarter. The wind in a storm is moving with a rotary motion, drawing from the outside toward the center of the storm. The rotation in the northern hemisphere is opposite to the motion of the hands of a clock, or over from east to west. This is caused by the rotation of the earth upon its axis. In the southern hemisphere the rotation and the winds in storms are in the opposite direction from what they are in the northern hemisphere. This is to be found fully discussed in Davis's "Meteorology," which we will mail for $2.50.

(11016) W. P. B. asks: 1. What can I mix with coal tar to dissolve it? A. Any of the hydrocarbon oils will dissolve asphaltum, or coal tar—gasoline, naphtha, benzine, kerosene, as also turpentine. 2. The house fly can use its legs and wings with great rapidity, the two fore legs as a man uses his hands. Are they moved by muscles? If not, by what? A. Flies and other insects move their legs and wings, and other parts also, by muscles as do the higher vertebrate animals. There is this difference, however, that the muscles of insects are not gathered into bundles terminated by tendons, as are those of the vertebrates, but are in straight fibers, not joined to each other in most cases. The fibers form layers which may be regarded as separate muscles. The fibers are composed of minute fibrillæ which have been seen to be striated as are the muscular fibers of vertebrates. It is hardly necessary to add that these fibers are very numerous, numbering several thousand in a single insect. The segments of the body are also well provided with muscles. Some of these go from the front of one segment to the front of the next, and others go to the rear of the next segment. Thus the segments can be tilted to and fro. The muscular strength of many insects is enormous, far exceeding that of the higher animals, relative to their weight. It is said that a flea can leap 200 times its own length. An equivalent leap for a man 6 feet would be 1,200 feet. A beetle has been known to sustain 500 times its own weight and creep out from under it. What would an equivalent load for an elephant be? For a man of 200 pounds in weight it would be 50 tons. Beetles often gnaw holes in lead pipes, and an instance is recorded of a European beetle gnawing a hole an inch in diameter in an iron canister in which it was confined, proving not only its muscular strength, but also the hardness of its mandibles. 3. Jupiter and Venus are now and have been in view near together. Approximately how far apart are they? A. When Venus and Jupiter are to be seen near each other in the sky Jupiter is nearly 500 millions of miles farther from us than is Venus, or about his own distance from the sun. 4. What can I put around the roots of trees from 1 to 4 inches in diameter to kill them? A. An ax at the root of a tree is the easiest mode of killing it. The simplest mode adopted in clearing new land by the early settlers was to girdle the trees near the ground and they were dead the next season. There is nothing which can be put into the ground to kill a tree that would not kill whatever else was growing there.

(11017) W. B. B. says: 1. In E. S. Lincoln's article in the Supplement for September 26, should not the formula $X = \frac{R(D-1)}{d}$ read $D - d$ instead of $D - 1$? Letting the currents corresponding to deflections D and d be represented by I and i respectively,

$$I = \frac{E}{R},\quad i = \frac{E}{RX}.$$

Whence, $$\frac{I}{i} = \frac{D}{d} = \frac{R+X}{R} = 1 + \frac{X}{R}.$$

This gives $$X = \frac{R(D-d)}{d}.$$

A. Your correction of the printer's error in the article seems to be justified, and to be all right. 2. If the efficiency of a motor is $\frac{E-e}{E}$, where E and e are the impressed and counter E.M.F. respectively, so that eI is loss, then to have efficiency 100 per cent, e must equal E, in which case no power at all would be used. At least that is the only way I can see it, though I have been studying the matter for years. In other words, if the motor uses any power at all, all the power it uses is loss and is therefore not used after all. Can you explain that so that I can understand? If it is not all loss, what part is not? A. Take care and do not conclude that a motor of 100 per cent efficiency would be a perpetual-motion machine. It is a queer inference that you make, "in which case no power would be used." What is to produce E to which for 100 per cent efficiency e becomes equal? Power must be spent every instant in forcing the motor against the counter electromotive force, and the current it generates, else there would be no motion of the motor and no counter electromotive force to be overcome by the impressed electromotive force. We suggest that you read the chapters in Carhart's "University Physics," vol. 2, upon "Electromagnetic Induction and the Efficiency of Motors." We will send the book for $1.75 postpaid.

(11018) O. B. F. asks: We want formula for painting concrete walls of a bathroom, so that it may be washed with water; would also like an enamel effect if it could be had. A. Cement may be painted with any waterproof washable paint, such as is used for bathrooms, if the caustic properties have become sufficiently neutralized by exposure for the paint to adhere. As this requires some time, it is often effected artificially as follows, with new concrete. Sponge the surface with a solution of 12 fluid ounces of oil of vitriol (H_2SO_4) to a gallon of water. This neutralizes any caustic lime present in the cement surface and turns it into the inert sulphate of lime (gypsum). It also roughens the surface so as to give the paint a firm hold. To remove final traces of alkali, wash with strong vinegar and allow it to dry thoroughly before applying the paint. Prime the surface treated as above with a coat of good old raw linseed oil, and let it dry and get quite hard; if applied liberally that will have stopped all the pores, and next put a coat of flat paint, composed of the necessary pigments, linseed oil, turpentine, and Japan dryer, which may be repeated if the first coat shows up unevenly, and finally, a finishing coat of weatherproof gloss paint or enamel. By the above method, you can use any colors you prefer, but if you wish to preserve the natural color of the cement, a wash of 1 part of water-glass (silicate of soda) to 3 parts rain water may be applied; this decomposes any lime present on the surface, and converts it into silicate, the surface becoming hard and glassy and entirely resisting the action of moisture.

(11019) W. K. asks: I am in a plumbing shop where they do some lead-burning occasionally, and in order to become thoroughly familiar with the theory I got a book from you on the subject, by Fay, in which it says that pure hydrogen can be produced from pure zinc or iron steeped in sulphuric acid; it further says that hydrogen for lead-burning is generally obtained by using ordinary spelter (and acid), and by this latter process we obtained very good results. We ran out of spelter one day and tried the iron, both cast as well as malleable, and we certainly obtained some kind of gas, but it would not burn with a blue flame; the flame was yellowish green; the addition of air from the mixing fork would not change its color; it was oxidizing and the lead would not unite. Now, I would like to know what kind of iron must be used to get a blue unoxidizing flame, or if there is a practical way to purify this gas so as to make it fit for burning acid to give a flame similar to that obtained from spelter, without making the lead-burning apparatus unhandy and complicated? A. We should not advise using iron for making hydrogen, nor sulphuric acid either. We use zinc or spelter, and hydrochloric acid, or as you may know it better by the older name, muriatic acid. You cannot get hydrogen rapidly by the use of pure zinc. Commercial zinc will yield hydrogen rapidly. If pure zinc is used a few drops of platinic chloride should be added to start the action. To prepare the spelter for the action of the acid it should be melted and poured from the ladle into a pail of water, slowly, so as to allow it to granulate. The large surface presented to the acid by granulated zinc will give a rapid evolution of gas.

(11020) J. C. B. asks: 1. Can the experiments made by means of the rectilineator be taken for granted as demonstrating the concavity of the earth? It was found that the earth curved concavely toward a straight line 8 inches the first mile, 32 the second, 72 the third, and the fourth mile the rectilineator touched the water. A. No experiments have ever been performed which proved the earth to be concave. It is not concave, but convex, and curves away from a straight line by 8 inches in the first mile, etc., as you give the figures for concavity. They are the figures for convexity. Within a few years the experiment to show the convexity of the earth by setting stakes in still water has been several times performed, and always with the result that the middle of a set of stakes is seen to be higher above a straight line than the end stakes. All astronomy, navigation, engineering, surveying and geography proceed upon the basis of a convex earth, and the results come out right. This conformity of fact to theory proves the theory to be true. 2. If the sun is such a great distance as 93 million miles from the earth, why is it in the morning or evening shining through clouds the rays of light seem so slanting? A. The slanting up of the sun's rays at rising or setting is due to the rays passing over our heads. As they come from the horizon and pass over us they must seem to pass from the horizon toward the place overhead. Thus they must seem to rise. If the earth were concave they would seem to descend and not to ascend.

(11021) J. W. E. L. asks: Your reply No. 10898 has brought to my mind a condition that I have often thought of. Am I about right in asserting that only a little more than 30 per cent of the energy stored in coal is available at the boiler stop valve? This in being converted into useful work at the engine is again so wasted that in ordinary triple marine engines about 8 per cent is available to propel the ship. A common type of marine engine is twin screw, four Scotch boilers, developing 5,000 I. H. P. I have often wondered what condition would be brought about by dividing the engine into four or six high-speed types, and building them *inside* the boilers. Practically I think that it could be accomplished, and I would value your opinion upon its theoretical efficiency. A. Your suggestion of putting the engines inside the boilers in order to save the heat lost by radiation is certainly novel and ingenious, but we fear it is hardly practicable. Your figures are about right as to the proportion of the heat energy in coal actually delivered by the engine in useful work, but the principal losses are not at points where they would be prevented by the insertion of the engines in the boilers. Of about 90 per cent total losses only 1.5 to 2 per cent is lost by radiation from main and auxiliary pipes and about 2 per cent or a little over in radiation from engine; these are the only losses which could be saved as you suggest, the balance being 1 per cent lost through grates, 5 per cent radiation from boiler, 20 per cent or more in chimney gases, and the balance in main and auxiliary exhausts. The theoretical advantages would therefore be hardly sufficient to justify such a change, apart from the practical disadvantages such as inaccessibility of the engine for repairs, etc.

(11022) E. E. L. asks: 1. I have a Wheatstone bridge arrangement the conductor of the four arms of which is ordinary tap water and into the circuit of the ordinary wire bridge is interposed an electro-magnet

arranged so that it may lift a small armature. Supposing that a dilute acid be poured into one of the arms, will a current flow through the bridge and will it be sufficient to lift the small armature? I intend using a small relay to lift a heavier armature; also a glass vessel for holding the water and carbon electrodes. A. The question you ask regarding a water resistance has only the answer that the current will lift the armature of an electro-magnet if you make it strong enough. The only way to determine the matter is to make the experiment. 2. Can a small dynamo be used for charging a condenser or, in other words, is it possible to charge a Leyden jar to the same capacity as with a frictional electric machine, by a direct continuous current? A. A dynamo will charge a condenser to its own voltage and no higher. It may be 110 volts, or some other voltage. When that is reached the action stops. As a friction machine has many thousands of volts in its spark, it can charge a condenser to a much greater height than a dynamo can do. An alternating current will not charge a condenser; a continuous current will do so.

NEW BOOKS, ETC.

THE WAR IN THE AIR AND PARTICULARLY HOW MR. BERT SMALLWAYS FARED WHILE IT LASTED. By H. G. Wells. New York: The Macmillan Company, 1908. 12mo.; 395 pages. Price, $1.50.

The author leads up to a peculiar situation in which the cockney hero finds himself marooned on Goat Island with the bridge to the American shore destroyed by the wreckage of a dirigible balloon, and cut off from the main land by the swirling Rapids. The hero, however, succeeds in getting hold of a damaged Japanese "heavier-than-air" machine and escapes. The book is filled with the most romantic, but not altogether impossible incidents. There is no question that the dirigible balloon and the heavier-than-air machine are both destined to play a very important part in the wars of the future. Mr. Wells writes as entertainingly as ever and is never unscientific. It must be said that his knowledge of New York geography is impeccable.

THE TEMPERATURE-ENTROPY DIAGRAM. By Charles W. Berry. New York: John Wiley & Sons, 1908. 12mo.; 300 pages, 109 illustrations. Price, $2.

In the revised edition of the Temperature-Entropy Diagram a more extended application of the principles of the $T\phi$-analysis to advanced problems of thermo-dynamics has been made than was possible in the limited scope of the previous edition. The chapter on the flow of fluids has been entirely rewritten and treats at length various irreversible processes. A graphical method of projecting from the pv- into the $T\phi$-plane has been elaborated for perfect gases and its application illustrated in the chapters on hot-air engines and gas engines. The various factors affecting the cylinder efficiency of both gas and steam-engines have been thoroughly discussed. One chapter has been devoted to the thermo-dynamics of mixtures of gases and vapors, and another to the description and use of Mollier's total energy-entropy diagram.

THE MECHANICAL ENGINEERING OF STEAM POWER PLANTS. By Frederic Remsen Hutton, E.M., Sc.D. New York: John Wiley & Sons, 1908. 8vo.; 825 pages, 700 illustrations. Price, $5 net.

A former edition of this book, issued in 1897, embodied the study and experience of the author gathered during the previous twenty years and brought together for teaching purposes. The years since then have been a period of great and rapid progress in the power plant and in all engineering departments contributory thereto; and while the old edition was modernized here and there and year by year, the time had come with the opening decade of the twentieth century that it be rewritten entirely. The present edition is the result of such rewriting. It is a new book so much enlarged that the old plates could not be used, but the size of page has been increased, new illustrations chosen, and many new topics and treatments have been introduced. While the former approved analytical view-point is retained and amplified, there has also been introduced a discussion in many chapters of the principles and data of applied mechanics attaching to the subject in hand. This has been done to enable teachers who desire to enliven the drill in the mathematical classes to find practical problems and applications of interest and future meaning, and to encourage teachers of the applications of theory to find easily the links and bases for such sound applications. The distinction between the applied thermal principles and those derivable from other departments of theory should tend also to clearness and benefit.

ALONG THE RIVIERA, FRANCE AND ITALY. Written and illustrated by Gordon Home. London: J. M. Dent & Co., 1908. New York: The Macmillan Company. 8vo.; pp. 328. Price, $3 net.

This is a beautifully made book, with most charming colored illustrations. The Riviera may be described as a collection of jewels strung together at irregular intervals on a rough mountain chain. Some are genuine antiques, others are overlaid with modern workmanship, and they vary much in size and shape, but the mediæval holds good nevertheless. It has been the author's endeavor to describe every place along the whole coast from Marseilles to Pisa, omitting only a few towns close to Genoa which have suffered through the growth of factories and uninteresting houses. There is nothing more delightful than an automobile trip over the perfect roads of the Riviera, and thousands of enthusiasts take this trip each year. The book is beautifully printed and bound and belongs to the series known as "Old World Travel." The aim of this new series is to describe both by pen and brush those parts of the Old World which travelers find most worthy of their attention, and to do for countries and districts what the same publishers' well-known "Mediæval Town" series has done for cities. The various volumes will prove not only welcome to the traveler during his visit, but will serve as pleasant reminders of bygone days, and will also bring the different districts vividly before the minds of those who are unable to leave home. The colored illustrations are in all cases reproduced from drawings actually made on the spot.

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending December 1, 1908.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Acetylene generator, portable, L. Troubetskoy 905,767
Agricultural implement, Fruecht & Zimmer. 905,808
Air and gas compressor, H. L. Borchers... 905,640
Air, humidifying, W. G. R. Braemer..... 905,143
Ammonia, manufacturing, F. W. Frerichs.. 905,415
Amusement device, A. Bragg 905,282
Anchor, post, C. L. Obinchain..... 905,215
Animal trap, C. B. Trumble..... 905,390
Anticollision device, A. Walker..... 905,774
Apron fastening device, M. J. O'Connor... 905,216
Arch support, W. H. Wood 905,617
Arcs, striking voltaic, A. J. Petersson.... 905,572
Atomizer spray head, T. A. De Vilbiss.... 905,296
Attrition mill plate, L. E. Bauer..... 905,492
Autographic register, C. M. Kirkland..... 905,710
Automatic draft regulator, hot water heating system, E. Berge 905,139
Automobile drawing mechanism, R. F. Stewart 905,244
Axle, J. C. Heinzelman 905,699
Axle spindle, turning, S. A. Davis..... 905,410
Barrel, W. P. De Laney, Jr..... 905,505
Basket, G. W. Hoffman 905,701
Battery cradles, device for suspending, E. Gruenfeldt 905,176
Bearing, E. Peckham 905,355
Bearing for looking glasses, etc., frictional, W. J. Sturgess 905,760
Bearing plate, roller center, Barber & Webb. 905,491
Bed, couch, E. Hunter 905,702
Bed, extension, J. P. Sundin 905,246
Bed, folding, F. Messel 905,448
Bed or sliding couch, extension, J. Schwartzman 905,466
Beds, etc., spring bottom for, G. B. Smith.. 905,243
Bedstead, extensible, G. Terpenning..... 905,764
Bedsteads, combined mosquito bar and table attachment for, M. E. C. Cowdrey..... 905,690
Bee feeder, W. L. Johnson 905,706
Beehive carrier, A. C. Brovald 905,643
Belt tension regulating mechanism, B. M. W. Hanson 905,525
Belt tightener, B. M. W. Hanson..... 905,526
Billiard table chalk attachment, Smith & Campbell 905,380
Binder, loose leaf, F. H. Crump 905,663
Binder, loose leaf, Maltby & Dom..... 905,726
Binder, temporary, G. H. Moore 905,559
Block, sheave pulley, Boat, ice, Mahony & Hopey 905,202
Boat, river, P. Sigaudy 905,377
Boiler alarm, W. Loudon 905,443
Bolt pointing machine, C. Sonneborn..... 905,600
Boot and shoe cleaner, E. M. Rich..... 905,583
Boring and turning mill, multiple, L. H. Farrier 905,680
Bottle, J. A. McKelvey 905,221
Bottle, E. Witman, Jr. 905,485
Bottle cooler, O. Kruger..... 905,439
Bottle stopper, Cauffman & Best..... 905,286
Bottle stopper, C. A. Hunt, Jr..... 905,431
Bottle washing machine spindle, E. Court.. 905,149
Bottles, etc., machine for wiring, C. A. V. Hallgren 905,696
Bottles or similar vessels, stopper for, T. B. Swahn 905,385
Box, A. L. Brown 905,145
Box, S. V. Wright 905,398
Box, T. S. Goff 905,691
Box, D. Fraser 905,806
Box lid support, H. C. French..... 905,807
Box opener, J. F. Dunn 905,160
Bread mixer, J. B. Collins 905,148
Bridle, blind, G. Holding 905,534
Brush holder, H. F. T. Erben 905,675
Butter separator, J. M. Fleming..... 905,302
Button, N. C. Newell 905,741
Cable terminal, J. E. McAteer..... 905,347
Calculating machine, W. F. Haussein..... 905,424
Calculating machine motor drive, F. M. Carroll 905,146
Calk, horseshoe, G. E. Lindberg..... 905,546
Can cover, J. R. Pratt 905,362
Can fusing and soldering machine for square, rectangular, or polygonal cans, Young & Symonds 905,268
Can, oil, W. S. McCracken..... 905,563
Can punch, Heber & Gunsel 905,427
Can seaming machine, H. Diecks..... 905,801
Cans, machine for fusing or soldering heads upon square or rectangular, F. Eberhart 905,300
Cans, sterilising sheet metal, J. G. Hodgson 905,315
Car, C. K. Pickles 905,359
Car cable grip, tram, H. O. Ofstad..... 905,217
Car door, S. P. Massey 905,445
Car, dumping, M. Orenstein 905,569
Car fender, F. T. Hardin 905,178
Car gate, dump, T. R. McKnight..... 905,222
Car, passenger, Curwen & Smith..... 905,665
Car, pleasure, J. D. Walsh 905,391
Car, railway, B. J. Leslie 905,820
Car roof, railway, J. Masker..... 905,340
Car side bearing, J. E. Norwood..... 905,743
Car truck center bearing, J. J. Skaben..... 905,754
Car truck, railway, E. G. Hoffmann..... 905,532
Car truck side bearing, J. J. Skaben..... 905,755
Car truck side frame and brake hanger, G. G. Floyd 905,105
Car underframe, J. S. Andrews 905,271
Car underframe, steam shovel, Adams & Howard 905,127
Carbonaceous materials, briqueting, W. T. Griffin 905,693
Card case, G. Coon 905,657
Card rack, H. E. Read 905,578
Carpet sweeper, J. T. Grzybowski 905,695
Carrier system, automatic, C. W. Larson.. 905,819
Caster, ball, J. Sterba 905,383
Casting machine, Ladd & Baker..... 905,194
Casting machine, line, D. S. Kennedy..... 905,541
Catch, automatic, F. Willimak..... 905,262
Cement burial vault, C. A. Gibson..... 905,416
Cement drain tile making machine, J. Cardiff 905,646
Cement, treatment of blast furnace slag for production of hydraulic, B. Grau..... 905,813
Chair. See Folding chair.
Chair display rack, Finney & Harper..... 905,163
Chair fan attachment, C. H. Towers..... 905,482
Chair seat, A. H. Barber 905,274
Chairs and the like, attachment for barbers', J. Mentz 905,447
Chalk and eraser holder, J. I. McAllister.... 905,450
Charging machine, E. Norton 905,214
Chlorin, dehydrating moist, E. A. Sperry... 905,602
Chuck actuating device, B. M. W. Hanson. 905,518
Cisterns, means for plugging the outlet pipes of, R. S. Godson 905,172
Cleaning device, Dugas & Richards..... 905,158
Clevis, M. Paveletz 905,223
Clock, A. L. Hahl 905,816
Closure, W. R. Comings 905,652
Cloth cutting machine, Mitchell & Barker.. 905,207
Clutch, J. F. Dornfeld 905,156
Clutch, O. B. Mitchell 905,209
Clutch and clutch operating mechanism, J. Maxwell 905,446
Clutch, combined friction and jaw, C. J. Widmer 905,260
Clutch, driving, A. P. Morrow 905,343
Coal or rock drilling machine, A. Ball..... 905,490
Coat and trousers hanger, combination, J. F. Claussen 905,498
Coating machine, M. A. Smith..... 905,472
Cock, compression, E. G. Hedges..... 905,181
Coin controlled lock, Smith & Hopkins 905,470
Colors, making lake, F. M. Winter..... 905,264
Column, V. I. Richards 905,750
Combing machine, M. Roth 905,233
Combing machine draw off device, C. Kroger 905,714
Compressor, air, C. W. Moore 905,211
Concrete structure reinforcing bar, A. Thomas 905,480
Condiment holder, J. B. Williamson..... 905,261
Controlling device, A. Balloco 905,135
Conveyer, A. W. Lind 905,337
Cooker, A. W. Morrell 905,212
Cooking utensil handle mechanism, J. C. Hollands 905,429
Copper and purifying, casting, and alloying the same, A. J. Rossi 905,232
Corn harvesting and husking machine, E. G. Calkins 905,408
Corn sheller, C. J. Widmer 905,259
Covering, portable, L. H. Troutman..... 905,708
Crank press, N. Sperber 905,601
Crate, folding, W. H. Wolf..... 905,779
Crystalline substances from liquor and drying the same, recovering, C. Ordway 905,568
Cultivator, J. Beard 905,277
Cultivator disk attachment, W. A. Biesenthal 905,786
Cultivator, rotary, L. Prue 905,577
Current clutch, alternating, A. G. Davis.. 905,797
Current generators in multiple, operating direct, F. W. Peek, Jr..... 905,746
Current magnet, alternating, T. E. Barnum 905,136
Current motor, A. K. Isham 905,320
Current motor, F. R. McCreary 905,346
Curtain pole, L. W. Bond 905,142
Curtain stretcher, C. L. Stolp..... 905,477
Curtain stretcher and drier, lace, M. Smith. 905,471
Cyclometers, mechanism for actuating, Weed & Casler 905,612
Dental appliance, E. E. Holmes 905,535
Dental articulator hinge, R. Sykora 905,479
Dentists' cuspidors, disinfector for, H. P. Roberts 905,369
Derrick, portable swinging, L. T. Mitchell.. 905,208
Die, Leffler 905,719
Dish staff, adjustable, H. E. Witherell.... 905,484
Disk propeller or game apparatus, W. J. Rigney 905,586
Display rack, C. Beall 905,635
Distribution system, L. Fleischmann 905,509
Ditching or tile laying machine, Matson & Benson 905,551
Dividers, P. Spiliadis 905,381
Door equalizer, E. A. Benjamin 905,137
Door hinge and brace, combined drop, C. W. Listerman 905,722
Door lock, sliding, G. M. Blair..... 905,494
Door, safe, J. M. Allen 905,623
Door stop, D. A. Fies 905,804
Draft equalizer, S. E. Ballor 905,133
Draft gear, W. M. Pond 905,360
Draft timber reinforcement, W. W. Decker. 905,152
Drawer, spring, Lambert & Dopps..... 905,544
Dress form, I. Levin 905,333
Dust guard, E. Peckham 905,356
Dyeing machine, Smith & Drum 905,473
Egg case or carrier, M. H. & L. B. Wilson. 905,615
Egg turner, C. L. Niz 905,742
Electric call bell, C. & W. Reinker..... 905,229
Electric controller, R. R. Root 905,588
Electric exhibitor, B. H. Winters..... 905,824
Electric fluid heater, J. S. Smyser..... 905,597
Electric heater, A. C. Dunham..... 905,159
Electric light bulb shield, R. R. Williams. 905,483
Electric machine, dynamo, C. M. Green... 905,512
Electric machine, dynamo, S. S. Forster.... 905,805
Electric machine, dynamo, C. M. Green.... 905,814
Electric machine, dynamo, F. B. Howell.... 905,817
Electric signaling system, E. E. Kleinschmidt 905,327
Electric vehicle motor control system, M. R. Thomas 905,497
Electric wire grounding clamp, W. H. Vibber 905,773
Electric wire seal, O. W. Neal, et al..... 905,349
Electrical conductor for dynamos, W. J. Richards 905,230
Electrical connector, P. E. Gilling..... 905,812
Electrical sealing cap apparatus, J. G. Swallow 905,761
Electrode, A. G. Davis 905,660
Electrode, negative pole accumulator, E. Sokal 905,599
Electromagnetic switch, T. E. Barnum..... 905,782
Electroresponsive device, E. A. Buckman... 905,495
Elevator. See Water elevator.
Elevator guide rails, means for lubricating, F. MacIndoe 905,724
Embalming fluid, J. L. Frye 905,168
Embroidery sewing stretching frame, S. V. Swoboda 905,247
Engine balanced valve, steam, F. Barngrover 905,275
Engine driving gear, petrol or gas internal combustion or steam, C. J. Montgomery. 905,823
Engine starting mechanism, explosive, W. R. Webster 905,611
Engines, admission valve and valve actuating mechanism for gas, G. B. Petsche. 905,224
Engines, water circulating apparatus for internal combustion, J. W. Smith 905,379
Engraving mill, C. A. Ker 905,708
Envelop, E. Hahn 905,307
Envelop, A. J. King 905,542
Envelop and wrapper, J. H. Hirst..... 905,313
Envelop, safety, W. E. Smith 905,757
Excavating apparatus, M. M. Defrees 905,153
Explosion engine, E. Apperson 905,625
Explosion motor, H. A. Bertheau..... 905,279
Explosive engine, A. F. Towle 905,389
Explosive engine, R. A. Maples..... 905,727
Explosive engine, R. A. Maples 905,822
Fan, blast, D. F. Lepley 905,195
Fan system, train, J. L. Creveling..... 905,292
Fans, operating pneumatically driven, J. L. Creveling 905,291
Fare register, Ohmer & Ketteman 905,218
Farm gate, F. Eggers 905,413
Farm gate, S. G. Hudson..... 905,430
Fastener, A. F. Raymond 905,456
Fastener, J. W. Place 905,454
Fastener, snap, A. F. Raymond 905,457
Fastening clip, collar, W. T. Gordon..... 905,418
Feed bag, D. C. Martin 905,549
Feed mechanism, Hanson & Post..... 905,520
Feed water regulator and alarm, T. R. Whittaker 905,614
Fence posts, constructing, Z. T. Crego..... 905,794
Fence stretcher, T. T. Rogers 905,751
Fiber stock from cornstalks and analogous plants, preparing, G. R. Sherwood..... 905,374
File handle, adjustable, R. A. Bacon..... 905,132
Filter press, continuous, A. J. Arbuckle.... 905,129
Fire and temperature alarm or indicator, G. L. Smith 905,578
Fire extinguisher, D. W. Diggs 905,298
Fishing reel, C. D. Rider 905,585
Fishing rod reel clamp, J. Hedden..... 905,428
Flanging machine, C. W. Sievert..... 905,376
Floor and ceiling plate, W. T. Broadbent... 905,144
Floor box and receptacle, N. H. Raymond.. 905,394
Flower box, E. Schaffer 905,598
Flower repairing device, I. L. Pillsbury.... 905,572
Fluid fuel feed regulator, steam boiler, J. D. MacLachlan 905,199
Fluid pressure regulating apparatus, G. E. Hulse 905,186
Flying machine, J. B. Macduff 905,547
Folding chair, W. R. Cameron 905,493
Folding table, Mohr & Mosch..... 905,742
Foot rest, J. F. Rossman 905,589
Fuel, artificial, G. W. Herbein..... 905,310
Fuse, device for locating a molten, F. Schultz 905,594
Fuse, non-explosive, F. B. Cook..... 905,503
Garment form, I. Levin 905,334
Garment supporter, A. P. Crossdale..... 905,150
Gas and vapor burner, combined illuminating, F. & A. H. McMillan..... 905,758
Gas engine, H. Sohnlein 905,598
Gas into vacuum tubes, device for admitting, H. Bauer 905,652
Gas producer, H. E. Smythe 905,474
Gas, producing insecticidal, H. V. Walker.. 905,469
Gas stove, P. Schlig 905,732
Gas tip, J. E. Frye 905,167
Gate, C. W. Raymond 905,363
Gate, J. J. Plowman 905,575
Gate, C. B. Stevens 905,393
Gate adjustable opening stop, head, C. D. Butchart 905,407
Gears, Evans mechanism, P. Evans..... 905,677, 905,678
Generators provided with auxiliary poles, control of separately excited, Fleischmann & Stern 905,508
Glass pot or tank, individual, J. I. Arbogast 905,489
Glass structure, wire, F. & A. Shuman..... 905,469
Glass tumblers, grinding, F. Woodruff..... 905,482
Globe support, W. & H. Anderson..... 905,128
Glove, R. Raymond 905,365
Gluing machine, J. F. Zapf 905,269
Grading machine, road, J. Rein 905,367
Grain or seed separating device, Hill & Brower, reissue 12,891
Graphophone tone modulator, O'Neef & Jenkins 905,220
Grid for openers, scutchers, and the like machines, R. Schaellibaum 905,237
Grinding machine, H. B. Robinson..... 905,461
Gun sighting apparatus, Dawson & Buckham 905,798
Hair curler, M. G. Decies 905,799
Hammer, J. G. Evans 905,676
Hammer or the like, A. G. Lundin 905,198
Hammer, pneumatic, C. R. Creen..... 905,692
Harness buckle, R. Warren 905,775
Hat packing device, A. H. Russell..... 905,592
Hay loader, J. Dain 905,151
Hay stacker, E. A. Rhoads..... 905,368
Headlight, L. Hiles 905,312
Heater. See Electric heater.
Heater, W. L. Moore 905,560
Heating apparatus, H. A. Biermann 905,140
Heating boiler, H. M. Wells 905,613
Hem and bias fold gage, combination, L. M. Springer 905,382
High frequency generator, alternating current, E. F. W. Alexanderson 905,621
Hinge, J. Magnusen 905,201
Hog catcher, H. Reichert 905,579
Hoisting apparatus, A. E. Norris..... 905,213
Hoisting machine automatic brake, F. E. Farmer 905,679
Hook, J. Ames 905,400
Hook and eye, W. M. Corthell 905,409
Hook and eye, M. G. Bunnell 905,825
Hopper dredgers and barges, discharge door of, F. Lobnitz 905,821, 906,338
Hoppie, J. T. Phillips 905,453
Horse cleaner, M. Connelly 905,655
Horse detacher, E. A. Collin 905,288
Horse releasing device, I. Harshman..... 905,698
Horseshoe, nailless, A. Gimbel 905,690
Horseshoe tip toe pad, P. J. Kernan..... 905,760
Hose coupling, automatic air brake, C. W. Rhodes 905,582
Hydro-extractor, Diamanti & Beuf..... 905,297
Ice making freezing tank, plate, F. Allen... 905,622
Injector, J. C. & R. D. Metcalfe..... 905,306
Inking rollers, making, J. P. Hennessey.... 905,182
Insect exterminator, W. J. Nanney..... 905,733
Instrument key, combination, H. E. French. 905,304
Insulated conductor, J. I. Mitchell 905,554
Insulator, L. L. Bogue 905,141
Insulator pin, metallic, C. G. Ette..... 905,414
Internal combustion engine, P. D. Johnston. 905,434
Internal combustion engine, A. J. Miller.. 905,753
Iron boiler, cast, A. B. Rock..... 905,366
Jar cap and opener, combined, H. C. Carnow 905,404
Kettle, M. E. French 905,685
Key carrying device, A. H. Merrill..... 905,731
Knife sharpener, A. von Brast..... 905,638
Knitting machines, mechanism for forming garter tops on stockings in circular, H. Rousman 905,185
Knockdown table, W. J. Maddox..... 905,200
Lamp, arc, C. A. B. Halvorson, Jr., 905,514, 905,515
Lamp, arc, J. T. H. Dempster..... 905,800
Lamp burner, oil, M. J. Hooper..... 905,183
Lamp extinguisher, H. Kovacic 905,543
Lamp globe cleaner, arc, R. H. Read..... 905,458
Lamp, incandescent, A. Swan..... 905,478
Lamp, incandescent electric, H. J. Jaeger.. 905,703
Lamp, multiple incandescent gas, J. A. Brandt 905,403
Lamp, vapor, E. Seitz 905,467
Land marker, J. W. Shell 905,595
Last, F. J. Swainey 905,240
Lathe tool post, G. N. & B. Chamberlain..... 905,648
Latrine incinerator, J. J. Conley..... 905,500, 905,501
Lawn mower, T. Rowe 905,591
Letter fastener, F. C. Bussert..... 905,406
Leveling rod, W. G. Lenker..... 905,441, 905,442
Lifting jack, J. S. Hearn 905,528
Light collector, arc, B. Monasch..... 905,557
Limbs, cushioned joint for artificial, J. F. Rowley 905,372
Lock, R. H. Pittman 905,574
Locomotive cab window, C. M. Goodrich.... 905,417
Logs, device for recovering sunken, J. B. Agnew, Sr. 905,620
Loom shuttle, S. A. Dudley 905,670
Looms, automatic weft replenishing mechanism for, M. L. Stone 905,245
Looms, electromagnetic stop mechanism for shuttle, D. Bacon 905,131
Lubricant, L. Chapman 905,649
Mail and baggage catcher, J. Schmitz..... 905,593
Mail delivery apparatus, W. A. Atwell..... 905,272
Mail, parcels, or the like, delivery apparatus for, S. H. Roby 905,370
Mail receiving and delivering apparatus, J. S. Lanier 905,718
Mailing or similar cases, labeling device for, I. W. Liggett 905,545
Malt house, W. H. Prinz 905,225
Manganese and ferromanganese, making, A. G. Betts 905,281

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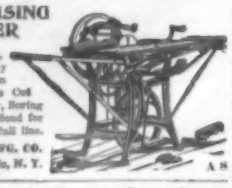

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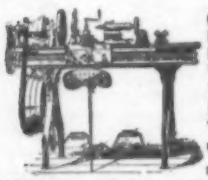

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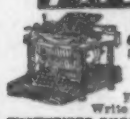

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THIS YEAR WE HAVE DONE SOMETHING ENTIRELY NEW

WE called on 1200 manufacturers of automobiles and accessories for suggestions. The result was eye-opening. For days and days suggestions came in, most of them illuminating, helpful, and instructive. We read over every one of those letters and made up our minds to use each in some way. We classified them carefully and turned them over to a corps of expert writers on automobiles, with instructions to EMBODY THESE IDEAS IN THE BEST SERIES OF PRACTICAL ARTICLES AND SHORT MEATY NOTES that ever appeared in any one issue of a magazine.

Among the articles will be one on the commercial truck and delivery wagon. It tells just what the commercial self-propelled vehicle is capable of doing, compared with the horse-drawn vehicle of the same type.

The average automobilist is not an engineer. When his machine stops, he is all but helpless. Many of the 1200 thought it would be an act of mercy to help him out. Mr. Roger Whitman, technical director of the New York School of Automobile Engineers, has prepared a "TROUBLE CHART," which a man can carry in his hat, if need be, and consult if he finds himself in mechanical straits. A glance at that chart will tell any intelligent man, woman, or child how to locate a defect and what to do if a car refuses to run.

Magneto Ignition, because it is comparatively new, is a subject on which the automobile user needs enlightenment. Just what magneto ignition is, how it compares with coil ignition, and the comparative advantages of high and low tension, are ably explained in a lucid article.

The Two-cycle Engine is another innovation which ought to be dealt with in the opinion of the trade. Mr. R. W. Roberts, a well-known authority on the subject, has prepared an article which sets forth simply and accurately what the two-cycle engine is, and what it will do to simplify and improve the automobile.

Tires are found to demand more in the way of repair and renewals than any other part of the car. A tire expert has prepared an article, which the tire manufacturer ought to welcome, simply because it informs the chauffeur what he ought to do and what he ought not to do, and places the blame for much tire trouble where it properly belongs—on the man who drives the car. We think we have succeeded in explaining some of the mysteries of tire construction, and that we have laid a heavy finger on the cause of the trouble.

"Lubricants and Lubrication" is made the subject of some straight talk by Mr. Hanauer, whose chief business in life at present is to lecture on oil and oil devices at the New York School of Automobile Engineers. The driver of a car is set right on the subject of lubricants, and informed what lubricant to use for the various parts of his car. Mr. Hanauer explains all this clearly. What is more, he gives a few simple tests which will indicate whether the oils are what they purport to be.

Repairs are charged for at piratical prices. Automobile manufacturers rail at the garage keeper, because he is not fair to their cars. He puts them in a bad light. No manufacturer cares to learn how many dollars his car cost in repairs, particularly if most of the repairs are easily made. So we intend to publish an article **"Making Your Own Repairs,"** which will pluck out a painful thorn and make the owner of a car at least partly independent of the exorbitant garage man.

There will be a page full of novelties—short, illustrated articles about clever automobile inventions that save time and labor. Many of them will give the reader a little thrill of mechanical pleasure to learn that such simple—we might almost say obvious—devices are conceived and manufactured. Every one of them is a mechanical short cut.

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Scientific American Supplement 997 contains an article by Spencer Newberry in which practical notes on the proper preparation of concrete are given.

Scientific American Supplements 1566 and 1569 present a helpful account of the making of concrete blocks by Spencer Newberry.

Scientific American Supplement 1534 gives a critical review of the engineering value of reinforced concrete.

Scientific American Supplements 1547 and 1548 give a resume in which the various systems of reinforced concrete construction are discussed and illustrated.

Scientific American Supplement 1564 contains an article by Lewis A. Hicks, in which the merits and defects of reinforced concrete are analyzed.

Scientific American Supplement 1551 contains the principles of reinforced concrete with some practical illustrations by Walter Loring Webb.

Scientific American Supplement 1573 contains an article by Louis H. Gibson on the principles of success in concrete block manufacture, illustrated.

Scientific American Supplement 1574 discusses steel for reinforced concrete.

Scientific American Supplements 1575, 1576, and 1577 contain a paper by Philip L. Wormley, Jr., on cement mortar and concrete, their preparation and use for farm purposes. The paper exhaustively discusses the making of mortar and concrete, depositing of concrete, facing concrete, wood forms, concrete sidewalks, details of construction of reinforced concrete posts.

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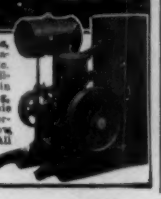

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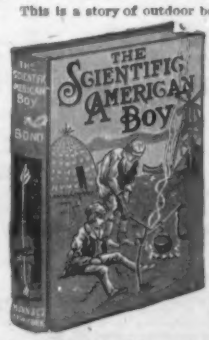

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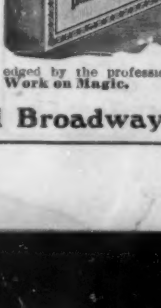

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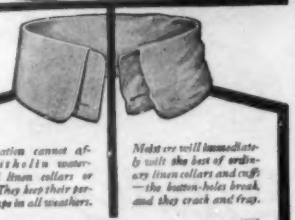

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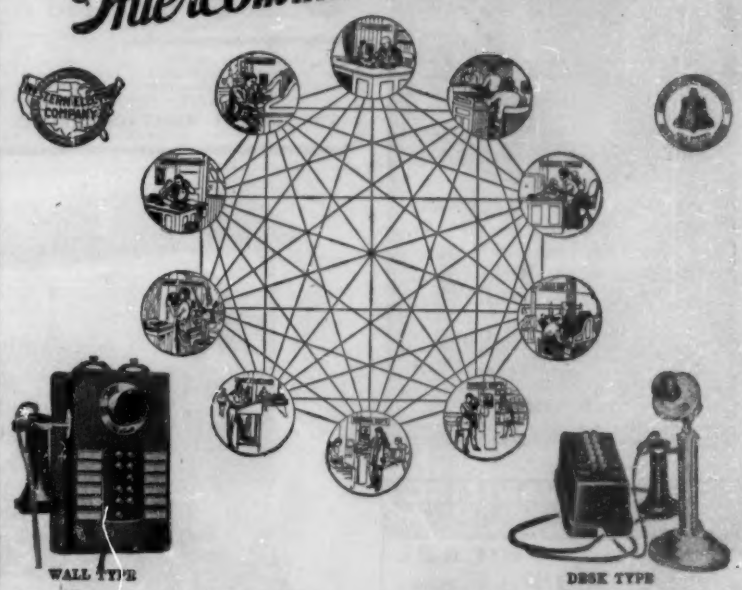

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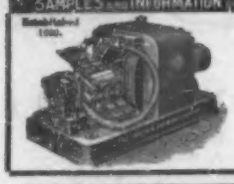

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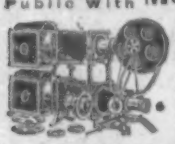

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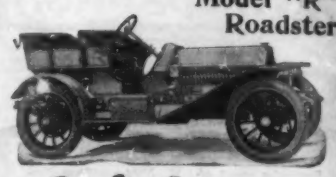

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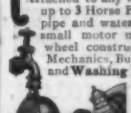

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